(2)

MALARIA CONTROL PROJECT FOR WORLD BANK FINANCING

STRENGTHENING MALARIA CONTROL IN INDIA

Directorate of National Malaria Eadication Programme
22-Sham Nath Marg
Delhi-110 054, INDIA

07955

Community Health Cell
Library and Information Centre
367, " Srinivasa Nilaya "
Jakkasandra 1st Main,
1st Block, Koramangala,
BANGALORE - 560 034.
Phone : 5531518 / 5525372
e-mail:sochara@vsnl.com

STRENGTHENING MALARIA CONTROL IN INDIA THROUGH WORLD BANK FINANCING

EXECUTIVE SUMMARY

1. INTRODUCTION

2. INTEGRATED MALARIA CONTROL

   2.1 OBJECTIVES

   2.2 MECHANISM

   2.3 INDICATORS

3. METHODOLOGY

   3.1 TECHNICAL ELEMENTS

   3.2 IDENTIFICATION OF PROBLEM AREAS

   3.3 GUIDELINES

4. ACTION PLAN

   4.1 DISEASE CONTROL

      4.1.1 EDPT

      4.1.2 REFERRAL

      4.1.3 DRUG POLICY

      4.1.4 DRUG DISTRIBUTION

      4.1.5 PRIVATE SECTOR

      4.1.6 MONITORING

   4.2 VECTOR CONTROL

      4.2.1 BIOENVIRONMENTAL METHODS

      4.2.2 SELECTIVE SPRAYING

      4.2.3 BED NETS

      4.2.4 PERSONAL PROTECTION

4.3 MALARIA CONTROL SUPPORT ACTIVITIES

4.3.1 HIA

4.3.2 INTERSETORAL COORDINATION

4.3.3 TRAINING

4.3.4 RESEARCH

4.3.5 COMMUNITY PARTICIPATION

4.3.6 NGOs

4.3.7 PRIVATE SECTOR

4.3.8 MIS

4.3.9 IEC

4.3.10 DECENTRALIZATION

4.4 EPIDEMIC CONTROL

4.4.1 EARLY WARNING SYSTEM

4.4.2 CONTROL STRATEGY

4.5 ASSESSMENT OF MALARIA SITUATION

5 SALIENT FEATURES OF THE REVISED MALARIA CONTROL STRATEGY

6. R & D support to the NMEP

7. POLICY ISSUES

8. FINANCIAL OUTLAYS

9. REFERENCES

ANNEXES

STRENGTHENING MALARIA CONTROL IN INDIA THROUGH WORLD BANK FINANCING

1. INTRODUCTION

Malaria is endemic in India and active transmission has been reported from almost all areas except those above 2000 msl and the coastal belts on western ghats. Some areas have very low receptivity like the state of Kerala and north Bihar. Malaria in India is largely unstable and therefore comes in waves after an interval of several years depending on immunological, environmental and meteorological factors. In north eastern region of the country malaria is stable and therefore its control has always been a problem. In the peninsular India populations living in the deep forests and forest fringe which is dominated by various ethnic groups is refractory to the residual spraying of insecticides. This population has been identified on the basis of high P. falciparum incidence. PHCs with >30% P. falciparum have been identified with deaths due to malaria and various levels of drug resistance problem. The total population is 61.2 million in 7 states, 97 districts, and 1045 PHCs. Urban areas have been identified on the basis of >10 SPR. Total population is 79.0 million in 19 towns. Figure 1 shows rural areas and towns identified for WB financing. By and large in rural areas it is the same population which had to be reverted from the consolidation and maintenance phase of the eradication programme to the attack phase. Before the launching of the National Malaria Control Programme in 1953 malaria was the single most important disease producing an estimated 75 million cases and 0.8 million

deaths in the normal years and these figures used to multiply during epidemic years (NMEP, 1960). DDT spraying under the National Malaria Eradication Programme nearly eradicated malaria from the country and by the early 1960s there were only about 100,000 cases. Due to DDT shortages and operational problems malaria started to return and its resurgence was widespread in the country (Sharma and Mehrotra, 1986). Rise in cases was initially suppressed but malaria outbreaks continued to surface even in those areas protected by the insecticides (NMEP, 1986). Thus in the last decade malaria situation has deteriorated to a point where its control requires renewed attack with new approaches (Sharma, 1995; Pattanayak et.al. 1994). The prevailing malaria situation in the country is summarized below:

1.1 Malaria in India was a rural disease. It has diversified in to five ecotypes with sub-ecotypes mainly comprising of man made changes in the ecology favoring vector breeding, and areas of undisturbed ecology largely in the forests and regions of rainfed agriculture. These ecotypes are: 1) Tribal malaria (sub-ecotype: 50 million population in deep forests and forest fringes, 20 million population in proximity of forest fringes); 2) rural malaria (sub-ecotype: 200 million population in command areas, 100 million population in rainfed rural areas without irrigation); 3) urban malaria (sub-ecotype: 100 million population in towns, 50 million peri-urban population); 4) industrial malaria 10 million population; border malaria 8 million population and 5) migration malaria 5 million population (Sharma et.al. 1994). Renewed attack on malaria requires an

understanding of the transmission dynamics of malaria in each ecotype and sub-ecotype and approaches based on the local situation.

1.2 The surveillance system is reporting about 2 million parasite positive cases each year for more than a decade (Figure 2 & Table 1). In-depth evaluation of NMEP observed that malaria incidence in the country is under-estimated (NMEP, 1985). It may be noted that in the 1980s malaria outbreaks were being witnessed which were contained by insecticidal spraying but in the 1990s these outbreaks have threatened to cover regions like the 1994 epidemic in western Rajasthan, Indo-Bhutan border and Manipur (Sharma,1995). To contain and abort these epidemics early warning system and improved MIS are needed.

1.3 P. falciparum infection accounts for about 40% cases. This is a killer parasite. The problem of resistance to chloroquine is increasing and resistance to long acting sulpha drugs has also appeared (Kondrashin, 1992; Mishra, 1995). A study on relative cost of anti-malarials in developing countries based on the cost of chloroquine taken as 1, the cost of amodiaquine 2.3 X, Sulphalene or sulphadoxine plus pyrimethamine (SP) 4.0 X, Quinine 15.5 X, Quinine plus tetracycline 19.8 X and Mefloquine plus SP 33.3 X. Figure 3 shows the trends in the evolution of chloroquine resistance in P. falciparum. Alternate drugs for treatment of malaria are limited, costly and more toxic. Areas under drug resistance require priority interventions to liquidate the foci.

1.4 In vector control there are two main problems. These are the resistance to insecticides and exophilic vector behavior. Combating resistance requires the use of replacement insecticides which are costly, imported, toxic and limited in number. Frequent escalation in the cost of insecticides as shown in Figure 4 is a major limiting factor in curtailing the field operations. Spraying is operationally difficult and spray targets seldom exceed above 50%. as revealed (Figure 5) by a study conducted by the NMEP (Sharma, 1987). Residual spraying technique is unsuitable for exophilic vector behavior as the vectors do not come in contact or avoid contact with sprayed surfaces (Das et.al. 1990; Kalra, 1991), and therefore malaria control requires the use of personal protection methods e.g., treated bed nets. Vector control therefore should change from total dependence on insecticides to integrated methods incorporating selective insecticidal application.

1.5 In malaria control, community was not involved at any stage of the field operations except in drug distribution under the modified plan of operation. This has raised peoples expectations from the NMEP without any supportive role of their own (Pattanayak and Roy, 1980). Malaria being a local and focal problem requires to be addressed locally with community support and decentralized planning. Furthermore a large number of non-governmental organizations (NGOs)/ voluntary agencies also have interest in malaria control but work in isolation. The required technical support and coordination is lacking. A programme designed to benefit the masses cannot succeed and sustain without

STATE-WISE EPIDEMIOLOGICAL SITUATION IN INDIA - 1990 TO 1994

S.No.	STATES/UTs	YEAR	POPULATION IN 000'S	BSC	BSE	POSITIVE	P.F	%PERCEN P.F	ABER	API	SFR	SPR	API	DEATHS
1.	ANDHRA PRADESH	1990	59405	7489681	7489681	104483	41224	39.46%	12.61	1.76	1.40	0.55	0.69	5
		1991	61091	7947338	7947338	82292	33390	40.58%	13.01	1.35	1.04	0.42	0.55	2
		1992	62266	8083152	8083152	80305	26594	33.12%	12.98	1.29	0.99	0.33	0.43	0
		1993	60874	8246869	8246714	86854	26703	30.74%	13.55	1.43	1.05	0.32	0.44	7
		1994	62811	8398017	8398017	90201	32286	35.79%	13.37	1.44	1.07	0.38	0.51	11
2.	ARUNACHAL PRADESH	1990	750	189899	189899	18227	2196	12.05%	25.32	24.30	9.60	1.16	2.93	1
		1991	755	189295	189295	18729	2985	15.94%	25.07	24.81	9.89	1.58	3.95	0
		1992	771	184001	184001	19113	3120	16.32%	23.87	24.79	10.39	1.70	4.05	0
		1993	837	225197	225197	29664	5072	17.10%	26.91	35.44	13.17	2.25	6.06	0
		1994	867	304048	304048	49703	9352	18.82%	35.07	57.33	16.35	3.08	10.79	0
3.	ASSAM	1990	23189	2076693	2076693	64871	38936	60.02%	8.95	2.80	3.12	1.87	1.68	16
		1991	23529	2412379	2412165	107572	72962	67.83%	10.25	4.57	4.46	3.02	3.10	36
		1992	23878	2343332	2343332	95168	62118	65.27%	9.81	3.99	4.06	2.65	2.60	20
		1993	24213	2684250	2684250	118401	78304	66.30%	11.09	4.89	4.41	2.92	3.24	48
		1994	24589	2437203	2437203	149951	88670	59.13%	9.91	6.10	6.15	3.64	3.61	68
4.	BIHAR	1990	81734	1892242	1861290	57814	37898	65.55%	2.28	0.71	3.11	2.04	0.46	7
		1991	86345	1672568	1643393	60332	39220	65.01%	1.90	0.70	3.67	2.39	0.45	14
		1992	90105	1522942	1505136	65362	43191	66.08%	1.67	0.73	4.34	2.87	0.48	21
		1993	91295	1530599	1519203	75845	48652	64.15%	1.66	0.83	4.99	3.20	0.53	2
		1994	91295	579263	579263	23358	13671	58.53%	0.63	0.26	4.03	2.36	0.15	11
5.	Delhi	1990	1181	99687	99687	4890	871	17.81%	8.44	4.14	4.91	0.87	0.74	1
		1991	1181	85211	85211	2879	499	17.33%	7.22	2.44	3.38	0.59	0.42	0
		1992	1181	79094	79094	848	202	23.82%	6.70	0.72	1.07	0.26	0.17	0
		1993	1181	91439	91439	2227	333	14.95%	7.74	1.89	2.44	0.36	0.28	0
		1994	1181	101003	101003	3456	275	7.96%	8.55	2.93	3.42	0.27	0.23	0
6.	GUJARAT	1990	40000	6806732	6806732	515926	142391	27.60%	17.02	12.90	7.58	2.09	3.56	84
		1991	40918	6235933	6235933	404735	122235	30.20%	15.24	9.89	6.49	1.96	2.99	37
		1992	40918	6773846	6773846	348532	98213	28.18%	16.55	8.52	5.15	1.45	2.40	28
		1993	41634	6817570	6817570	304109	78051	25.67%	16.38	7.30	4.46	1.14	1.87	25
		1994	44184	6861820	6861820	248624	65379	26.30%	15.53	5.63	3.62	0.95	1.48	14
7.	HARYANA	1990	17091	2557524	2557524	50381	3617	7.18%	14.96	2.95	1.97	0.14	0.21	0
		1991	17593	2274879	2274879	34011	1142	3.36%	12.93	1.93	1.50	0.05	0.06	0
		1992	17906	2058650	2058650	16662	1238	7.43%	11.50	0.93	0.81	0.06	0.07	1
		1993	18039	2014650	2014650	22032	985	4.47%	11.17	1.22	1.09	0.05	0.05	0
		1994	18420	2202334	2202334	29810	1709	12.44%	11.96	1.62	1.35	0.17	0.20	0

8. HIMACHAL PRADESH	1990	4028	695304	681787	14379	29	0.20%	16.93	3.57	2.11	.00	0.01	0
	1991	4078	732494	724531	20115	5	0.02%	17.68	4.91	2.76	.00	.00	0
	1992	4124	708111	703301	7251	9	0.12%	17.05	1.76	1.03	.00	.00	0
	993	4288	668808	665928	4062	2	0.05%	15.53	0.95	0.61	.00	.00	0
	1994	4288	600159	597549	3091	6	0.19%	13.94	0.72	0.52	.00	.00	0
											ERR	ERR	
9. JAMMU & KASHMIR	1990	3336	373065	373016	5481	223	4.07%	11.18	1.64	1.47	0.06	0.07	0
	1991	3408	336868	336245	4650	11	0.24%	9.87	1.37	1.38	.00	.00	0
	1992	3446	278726	277103	1244	11	0.88%	7.61	0.34	0.45	.00	.00	0
	1993	3777	297303	295485	784	12	1.53%	7.82	0.21	0.27	.00	.00	0
	1994	3794	333050	333025	2760	48	1.74%	8.79	0.73	0.83	0.01	0.01	0
10. KARNATAKA	1990	38740	6601484	6601484	74012	22976	31.04%	17.04	1.91	1.12	0.35	0.59	0
	1991	38740	6646213	6646213	44565	9875	22.16%	17.16	1.15	0.67	0.15	0.25	8
	1992	38936	6913592	6913592	81057	16578	20.45%	17.76	2.08	1.17	0.24	0.43	0
	1993	39068	7098519	7098519	196466	40484	24.68%	17.81	4.93	2.77	0.68	1.22	0
	1994	39068	7110997	7110997	266079	37789	14.17%	17.84	6.69	3.75	0.53	0.95	3
11. KERALA	1990	28750	1703542	1667642	6411	153	2.39%	5.80	0.22	0.38	0.01	0.01	1
	1991	29270	1574910	1543334	6758	186	2.75%	5.27	0.23	0.44	0.01	0.01	0
	1992	29895	1404382	1373497	8255	224	2.71%	4.59	0.28	0.60	0.02	0.01	2
	1993	29993	1266410	1244421	9277	238	2.57%	4.15	0.31	0.75	0.02	0.01	0
	1994	30357	1117121	1091362	9075	273	3.01%	3.60	0.30	0.83	0.03	0.01	0
12. MADHYA PRADESH	1990	65421	6823296	6823296	224502	109197	48.64%	10.43	3.43	3.29	1.60	1.67	3
	1991	66136	6915958	6911825	282681	165428	58.52%	10.45	4.27	4.09	2.39	2.50	28
	1992	67789	7197837	7197837	269930	152499	56.87%	10.62	3.98	3.75	2.13	2.26	39
	1993	69446	7522941	7522941	283600	150097	52.93%	10.83	4.08	3.77	2.00	2.16	12
	1994	71231	7816561	7816561	322628	151502	46.96%	10.97	4.53	4.13	1.94	2.13	28
13. MAHARASHTRA	1990	74644	9636193	9636193	113266	36596	32.31%	12.91	1.52	1.18	0.38	0.49	6
	1991	77626	9363327	9363327	145310	53793	37.02%	12.06	1.87	1.55	0.57	0.69	15
	1992	81458	10375206	10375206	203812	61104	29.98%	12.74	2.50	1.96	0.59	0.75	2
	1993	83467	10491235	10491235	252475	71529	28.33%	12.57	3.02	2.41	0.68	0.86	15
	1994	85357	11623186	11623186	277657	82229	29.61%	13.61	3.25	2.39	0.71	0.96	9
14. Manipur	1990	1729	194568	194568	601	275	45.76%	11.25	0.35	0.31	0.14	0.16	0
	1991	1826	194150	194150	640	325	50.78%	10.63	0.35	0.33	0.17	0.18	0
	1992	1866	194739	194739	2119	916	43.23%	10.44	1.14	1.09	0.47	0.49	9
	1993	1866	186236	186236	1896	781	41.19%	9.98	1.02	1.02	0.42	0.42	9
	1994	1867	163361	163361	7462	5101	68.09%	8.75	4.01	4.59	3.12	3.93	58
15. MEGHALAYA	1990	1731	147756	147756	8209	5692	69.33%	8.54	4.74	5.56	3.85	3.29	0
	1991	1778	208872	208872	11155	7413	66.47%	11.75	6.27	5.34	3.56	4.18	0
	1992	1828	206909	206909	11281	6863	60.83%	11.44	6.24	5.45	3.32	3.86	2
	1993	1862	178464	178464	10279	6429	62.54%	9.68	5.54	5.61	3.60	3.60	0
	1994	1862	180564	180564	10279	7130	64.85%	9.91	5.83	5.66	3.82	3.74	63

16. MIZORAM	1991	655	186713	186713	12486	5798	46.44%	28.51	19.06	6.69	3.11	8.85	12
	1992	670	259580	259580	20592	11364	55.19%	38.74	30.73	7.93	4.38	16.96	36
	1993	675	214359	214359	13166	6544	49.70%	31.76	19.51	6.14	3.05	9.69	33
	1994	710	204993	204993	13998	7327	52.34%	28.87	19.72	6.83	3.57	10.32	41
17. NAGALAND	1990	1043	37299	37299	2406	570	23.69%	3.58	2.31	6.45	1.53	0.55	0
	1991	1215	39626	39626	2422	533	22.01%	3.26	1.99	6.11	1.35	0.44	0
	1992	1215	33634	33634	2218	432	19.48%	2.77	1.83	6.59	1.28	0.36	0
	1993	1275	26955	26955	1584	284	17.93%	2.11	1.24	5.88	1.05	0.22	0
	1994	1275	38000	38000	2098	432	20.59%	2.98	1.65	5.52	1.14	0.34	253
18. ORISSA	1990	30057	3345706	3345706	290115	245806	84.73%	11.13	9.65	8.67	7.35	8.18	147
	1991	31062	3962971	3962971	414550	351062	84.69%	12.76	13.35	10.46	8.86	11.30	233
	1992	31505	3747038	3747038	362390	307056	84.73%	11.89	11.50	9.67	8.19	9.75	155
	1993	31505	3323788	3320518	323576	274947	84.97%	10.54	10.27	9.74	8.28	8.73	118
	1994	37354	3264061	3264061	332066	284403	85.65%	8.74	8.89	10.17	8.71	7.61	78
19. PUNJAB	1990	20129	2226775	2226775	29336	579	1.97%	11.06	1.46	1.32	0.03	0.03	0
	1991	20547	2574396	2574396	36649	365	1.00%	12.53	1.78	1.42	0.01	0.02	0
	1992	21143	2535885	2535885	23225	184	0.79%	11.99	1.10	0.92	0.01	0.01	0
	1993	21539	2494395	2494395	15944	73	0.46%	11.58	0.74	0.64	.00	.00	0
	1994	21894	2575691	2575691	15601	185	1.19%	11.76	0.71	0.61	0.01	0.01	0
20. RAJASTHAN	1990	35854	3567539	3567539	114689	32500	28.34%	9.95	3.20	3.21	0.91	0.91	65
	1991	43881	3179925	3179925	77573	16097	20.75%	7.25	1.77	2.44	0.51	0.37	10
	1992	43880	3833880	3833880	121499	41513	34.17%	8.74	2.77	3.17	1.08	0.95	55
	1993	44005	3644944	3644944	107797	26387	24.48%	8.28	2.45	2.96	0.72	0.60	19
	1994	44005	4525430	4525430	229772	88310	38.43%	10.28	5.22	5.08	1.95	2.01	452
21. SIKKIM	1990	225	24927	24927	17	4	23.53%	11.08	0.08	0.07	0.02	0.02	0
	1991	236	26909	26909	46	4	8.70%	11.40	0.19	0.17	0.01	0.02	0
	1992	245	28305	28305	208	149	71.63%	11.55	0.85	0.73	0.53	0.61	1
	1993	259	20916	20916	68	36	52.94%	8.08	0.26	0.33	0.17	0.14	0
	1994	259	16575	16575	58	8	13.79%	6.40	0.22	0.35	0.05	0.03	1
22. TAMILNADU	1990	55897	5003741	5003741	120029	7039	5.86%	8.95	2.15	2.40	0.14	0.13	0
	1991	55918	5187871	5187871	144762	12193	8.42%	9.28	2.59	2.79	0.24	0.22	4
	1992	56763	6016637	6016637	151633	12112	7.99%	10.60	2.67	2.52	0.20	0.21	2
	1993	57925	6370485	6370485	148057	8844	5.97%	11.00	2.56	2.32	0.14	0.15	0
	1994	57925	5508888	5348829	96731	4229	4.37%	9.23	1.67	1.81	0.08	0.07	7
23. TRIPURA	1990	2407	210106	207595	6633	5068	76.41%	8.62	2.76	3.20	2.44	2.11	4
	1991	2750	174985	170912	6992	5316	76.00%	6.21	2.54	4.09	3.11	1.93	7
	1992	2756	179404	175393	9350	6970	74.55%	6.36	3.39	5.33	3.97	2 53	6
	1993	2757	188367	185565	9206	7223	78.46%	6.73	3.34	4.96	3.89	3.62	19
	1994	2827	236334	232243	8871	6975	78.63%	8 22	3 14	3 82	3 00	3 47	20

24. UTTAR PD.	1990	127444	9396000	9371000	103222	7645	7.41%	7.35	0.82	1.10	0.08	0.06	0
	1991	129182	9724000	9695000	112118	9112	8.13%	7.50	0.87	1.16	0.09	0.07	0
	1992	130494	9924000	9901000	119242	13124	9.11%	7.58	1.04	1.32	0.13	0.09	0
	1993	131260	9664000	9659000	114017	5930	5.20%	8.60	0.87	1.32	0.07	0.05	0
	1994	131260	7489061	7397319	94789	6006	6.34%	5.64	0.72	1.28	0.08	0.05	0
25. WEST BENGAL	1990	57697	1810243	1810243	27531	3690	13.40%	2.79	0.48	1.71	0.23	0.06	4
	1991	57822	1845197	1845197	40452	7771	19.21%	3.19	0.70	2.19	0.42	0.13	13
	1992	58766	2474897	2474897	49130	3690	7.51%	4.21	0.84	1.99	0.15	0.06	43
	1993	59158	2077909	2077909	46138	6763	14.66%	3.51	0.78	2.22	0.33	0.11	37
	1994	59158	2446968	2216207	69343	12021	17.34%	3.75	1.17	3.13	0.54	0.20	45
26. A & N ISLANDS	1990	286	150723	150723	2391	372	15.56%	52.33	8.30	1.59	0.25	1.29	0
	1991	297	141822	141822	1765	296	16.77%	47.75	5.94	1.24	0.21	1.00	2
	1992	306	160992	160992	1688	297	17.59%	52.61	5.52	1.05	0.18	0.97	1
	1993	344	161777	161777	1498	300	20.01%	47.01	4.65	0.99	0.20	0.93	1
	1994	359	169281	169281	1617	270	16.68%	51.05	4.51	0.98	0.19	0.78	0
27. CHANDIGARH	1990	600	147004	147004	26813	94	0.35%	24.50	44.69	18.24	0.06	0.16	0
	1991	635	153645	153645	26046	31	0.12%	24.20	41.02	16.95	0.02	0.05	0
	1992	650	147436	147436	17559	29	0.17%	22.68	27.01	11.91	0.02	0.04	0
	1993	660	115697	115697	9735	31	0.32%	17.53	14.75	8.41	0.03	0.05	0
	1994	670	98233	98233	7853	59	0.75%	14.66	11.72	7.99	0.06	0.09	1
28. D & N HAVELI	1990	104	23633	23633	5015	190	3.79%	22.72	48.22	21.22	0.80	1.83	0
	1991	138	24903	24903	5101	362	7.10%	18.05	36.96	20.48	1.45	2.62	0
	1992	138	44412	44412	6676	787	11.79%	32.18	48.38	15.03	1.77	5.70	0
	1993	126	47138	47138	8121	865	10.65%	34.16	58.85	17.23	1.84	6.27	0
	1994	138	41494	41494	8571	1362	15.89%	30.07	62.11	20.66	3.28	9.87	0
29. DAMAN & DIU	1990	99	19925	19463	770	44	5.71%	19.66	7.78	3.96	0.23	0.44	0
	1991	101	21304	21304	1010	33	3.27%	21.09	10.00	4.74	0.15	0.33	0
	1992	101	26409	26409	1199	86	7.17%	26.15	11.87	4.54	0.33	0.85	0
	1993	101	24041	24041	1565	45	2.88%	23.80	15.50	6.51	0.19	0.45	0
	1994	101	21345	21345	1230	47	3.80%	21.13	12.24	5.79	0.22	0.47	0
30. DELHI	1990	8721	1070102	1070102	12044	89	0.74%	12.27	1.38	1.13	0.01	0.01	0
	1991	8852	988842	988842	8491	24	0.28%	11.17	0.96	0.86	.00	.00	0
	1992	9373	1122350	1122350	11241	90	0.80%	11.97	1.20	1.00	0.01	0.01	1
	1993	9373	1050623	1050623	8201	19	0.23%	11.21	0.87	0.78	.00	.00	0
	1994	9373	957493	957493	4914	13	0.26%	10.22	0.52	0.51	.00	.00	0
31. LAKSHADWEEP	1990	50	1556	1556	6	0	00.00%	3.11	0.12	0.39	0.00	0.00	0
	1991	51	2724	2724	4	1	00.00%	5.34	0.08	0.15	0.00	0.00	0
	1992	51	2343	2343	1	0	00.00%	4.59	0.02	0.04	0.00	0.00	0
	1993	51	4002	4002	5	5	100.00%	7.85	0.10	0.12	0.12	0.10	0
	1994	52	2057	2057	2	0	00.00%	5.11	0.04	0.08	0.00	0.00	0

32. PONDICHERRY	1990	728	-206295	206295	389	1	0.26%	28.34	0.83	0.19	.00	.00	0
	1991	728	239209	239209	563	4	0.71%	32.86	0.77	0.24	.00	0.01	0
	1992	814	246285	246285	1034	13	1.26%	30.26	1.27	0.42	0.01	0.02	0
	1993	814	240455	240455	914	5	0.55%	29.54	1.12	0.38	.00	0.01	0
	1994	814	212067	212067	548	9	1.64%	26.05	0.67	0.26	.00	0.01	0
TOTAL	1990	810721	76014030	75869739	2024492	751990	37.14%	9.36	2.80	2.67	0.99	0.93	353
	1991	835808	76646297	76507864	2123578	918349	43.25%	9.15	2.54	2.78	1.20	1.10	421
	1992	853446	80317649	80288909	2131962	870284	40.82%	9.40	2.50	2.66	1.09	1.02	422
	1993	862646	79070510	78999211	2214812	852220	38.48%	9.16	2.57	2.80	1.06	0.99	345
	1994	878695	78609040	78070834	2385097	904229	37.91%	8.88	2.71	3.06	1.16	1.03	116

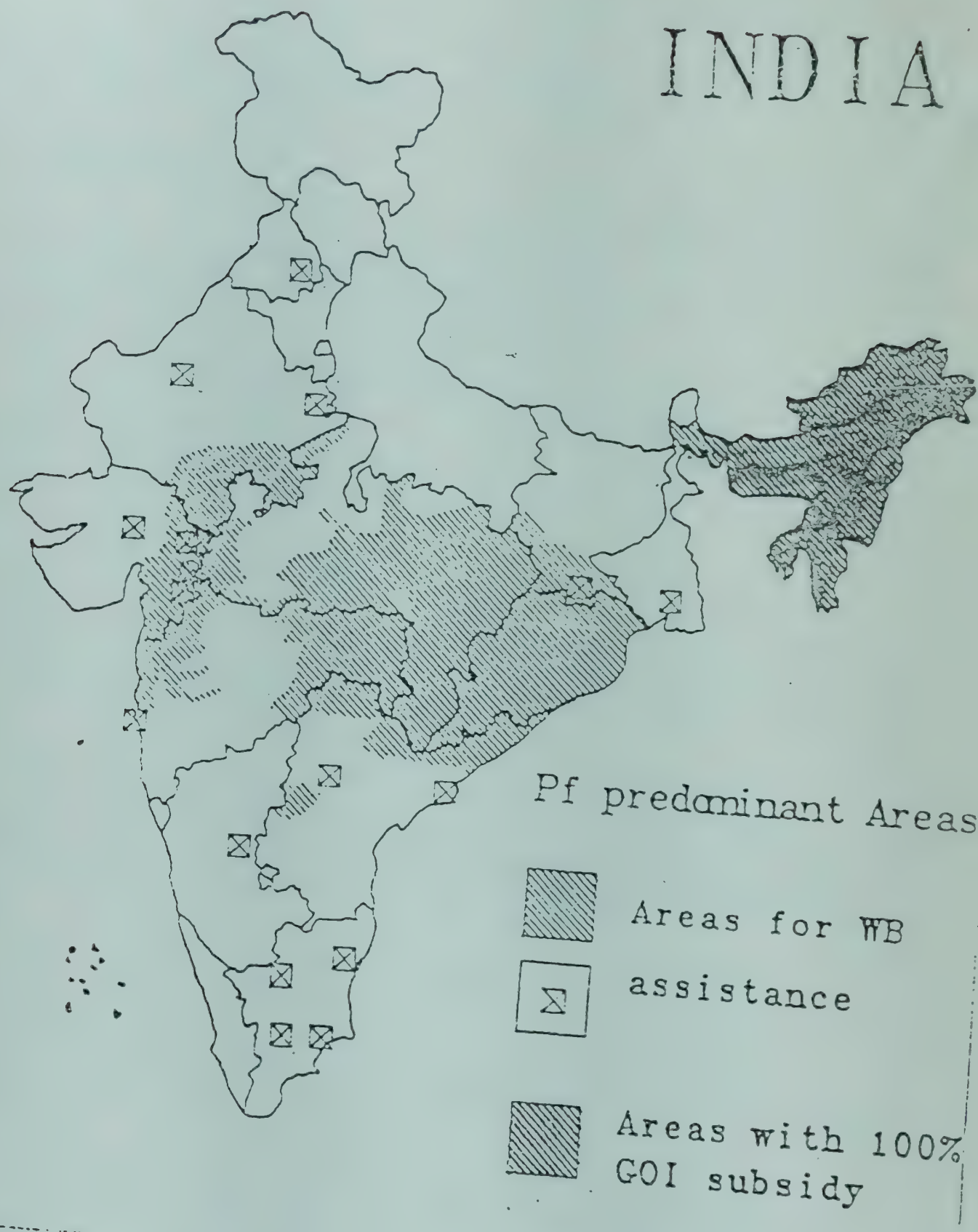


Figure 1 : P. falciparum predominantly PHCs, based on > 30% Pf in year a) peninsular India There are 7 states, 97 districts and 1045 PHCs in peninsular India requiring accelerated malaria control. (b) Northeastern states: in states malaria control has been made a centrally sponsored scheme and (c) In addition 19 towns with > 10 SPR have been identified for WB assistance.

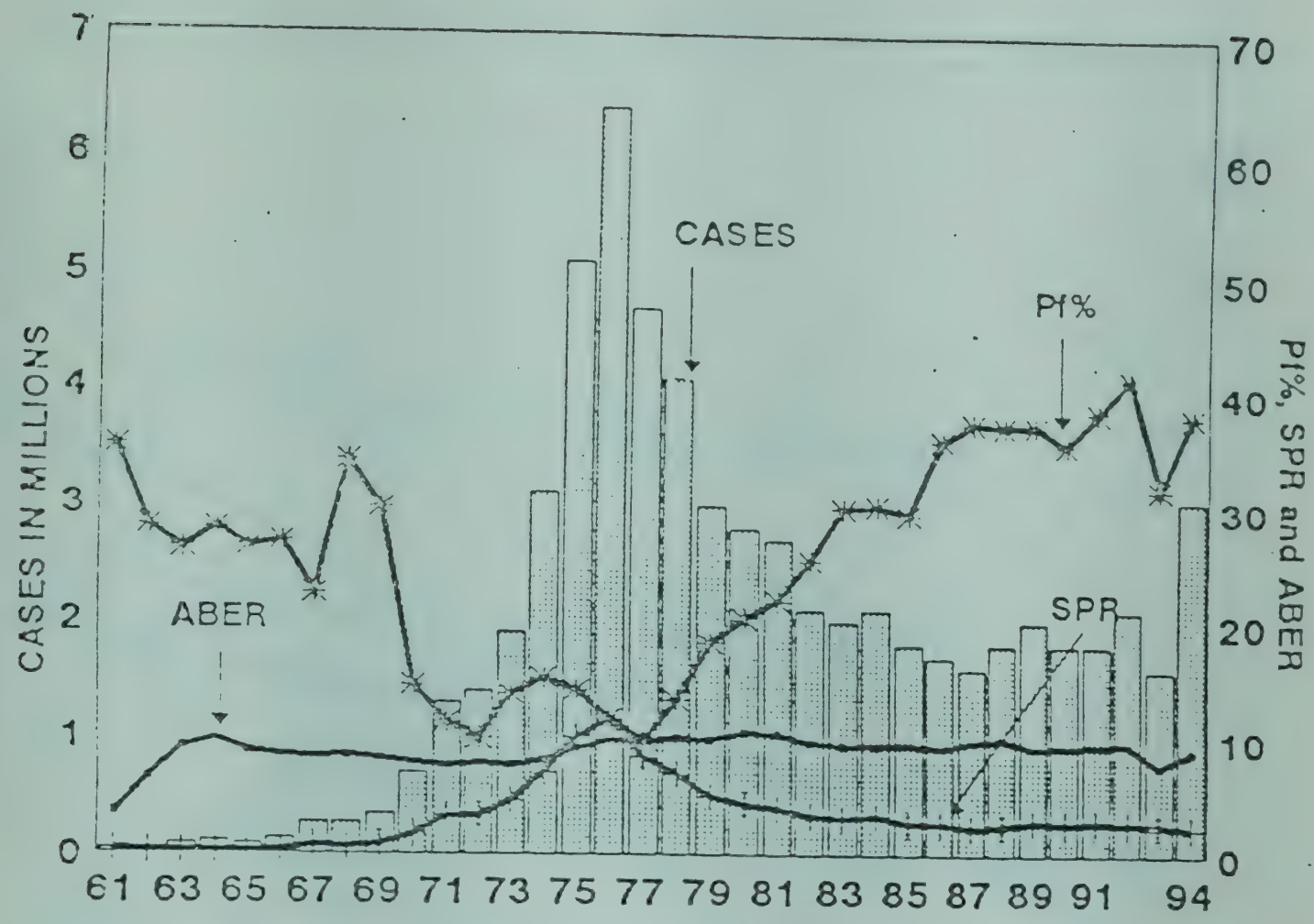


Figure 2: Epidemiological profile of malaria in India since 1961. Malaria cases reached the highest number of 6.5 million in 1976. Implementation of the modified plan of operation in 1977 reduced malaria cases but had no impact on P. falciparum which remained around 0.8 million cases annually. Annual blood examination rate (ABER) has remained at about the expected value of 10. In 1994 there was rise in malaria cases.
Cases.

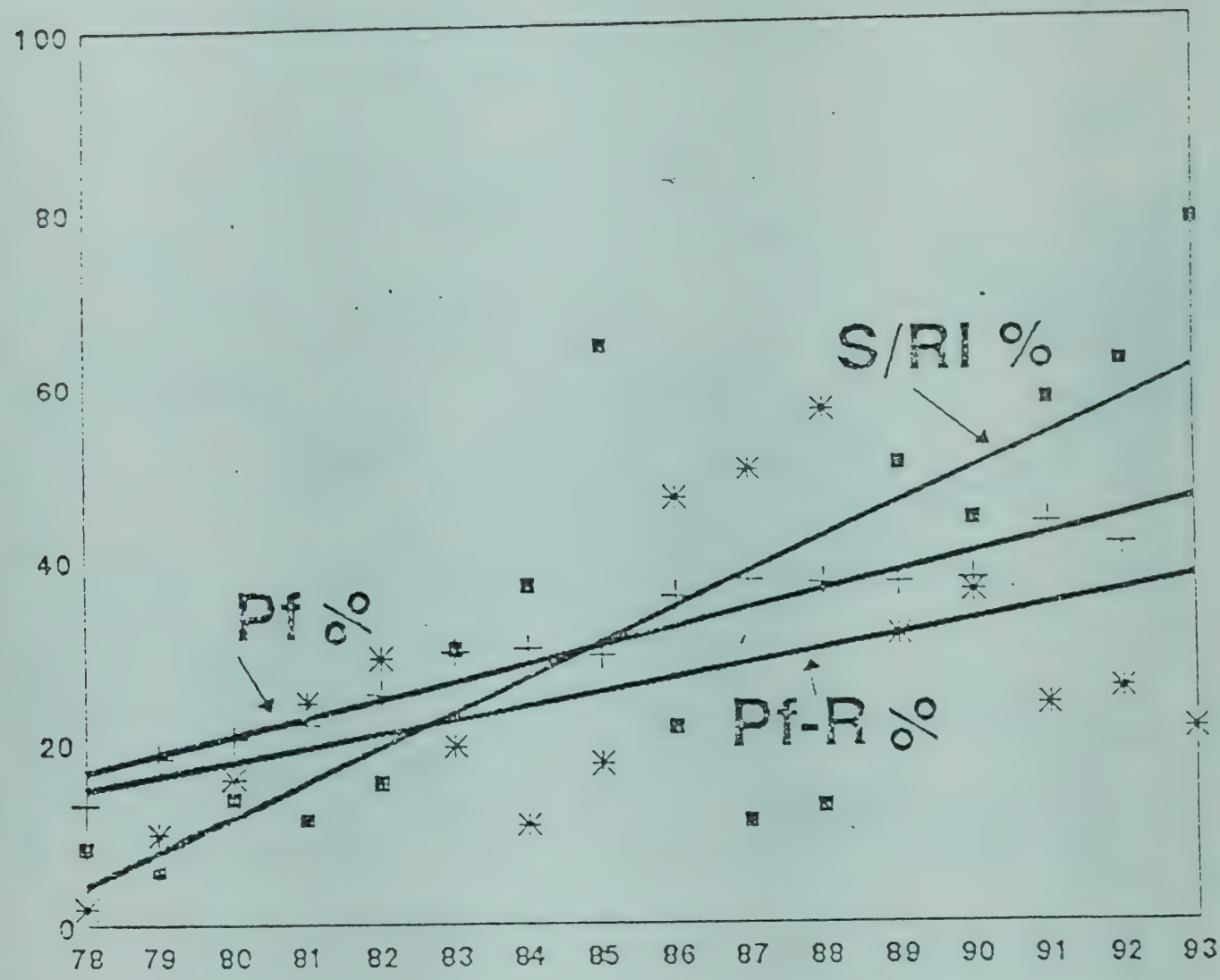


Figure 3: P. falciparum parasite (responsible for almost all malaria deaths) is becoming resistant to chloroquine. Trend line shows the rising trend P. falciparum and the problem of chloroquine resistance is also rising, parallel to the rise in P. falciparum.

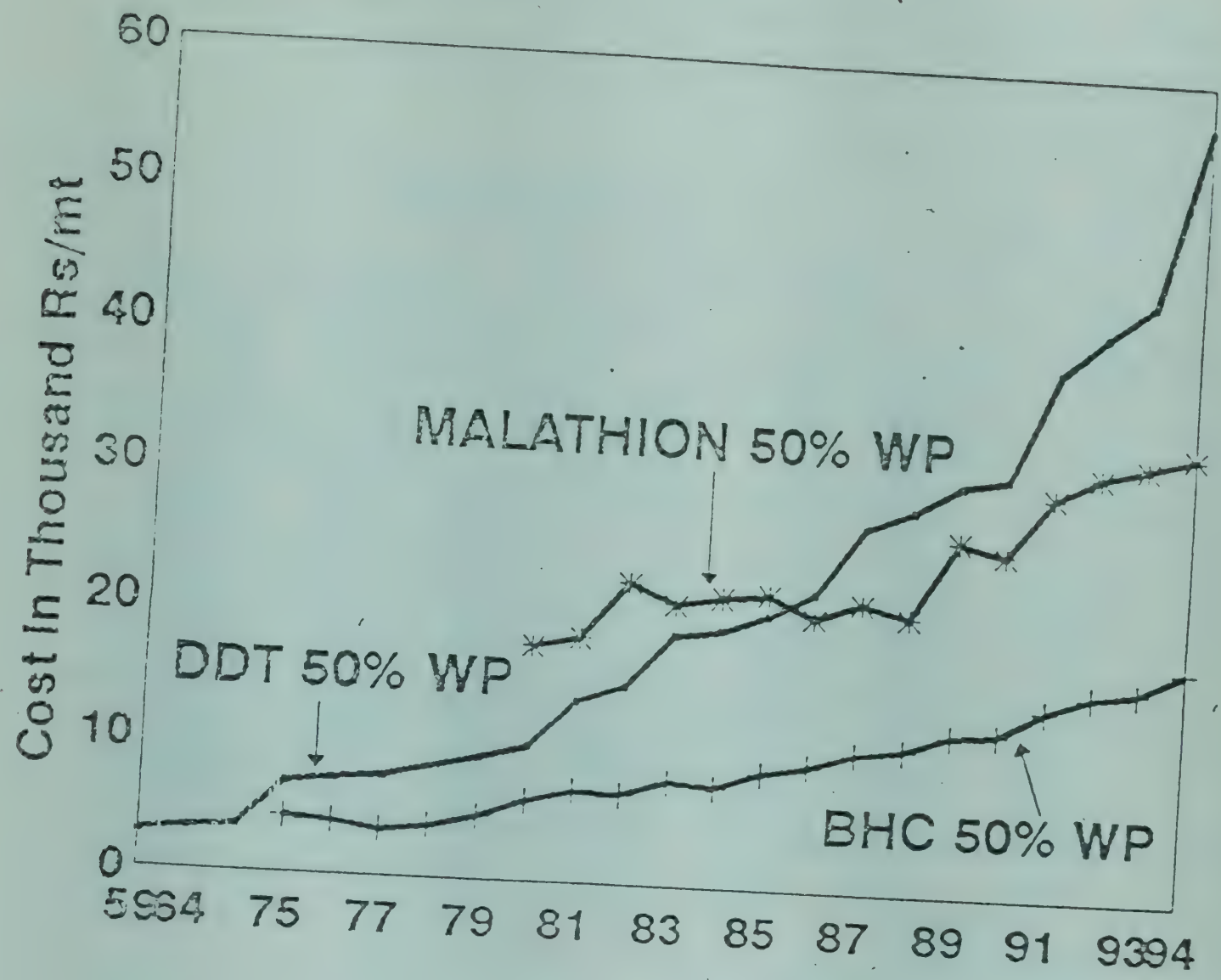
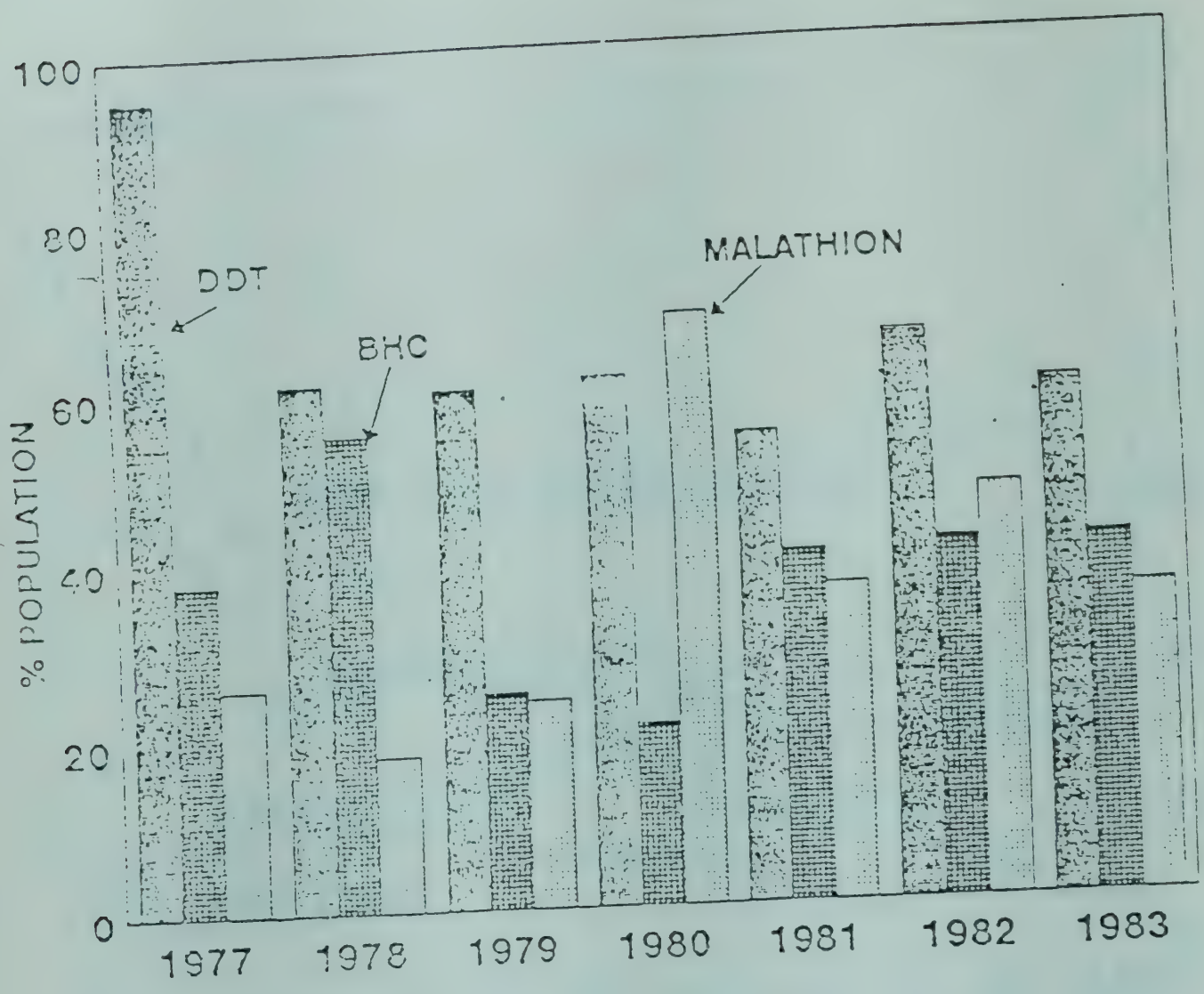


Figure 4: Spraying of insecticides (DDT, HCH, Malathion) was the main stay of malaria control. (Source: NMEP, New Delhi)



Source: NMEP

Figure 5: An operational study by NMEP showed that insecticidal coverage as per the insecticide consumed under the modified plan of operation seldom exceeded 50%. Spraying was operationally difficult and refusals to allow dwellings to be sprayed was the main obstacle in achieving spray targets (Source: HIL, New Delhi).

the active involvement and support of the communities. This component should be strengthened through the IEC.

1.6 Major ecological changes have occurred throughout the length and breadth of the country, and these changes would continue to occur at an accelerated pace under the 5-year development plans (Sharma and Kondrashin, 1991; Pattanayak et.al. 1994). Some examples related to the creation of malariogenic conditions are: irrigation in 1951 was 26.8 mh and in 1991 76.6 mh; rural water supply is targeted 100% and urban water supply 94.4% by 1998. Deforestation has reduced forest cover from 40.48 mh in 1950 to 22.30 in 1991; rice paddy cultivation has increased from 30.81 mh in 1950 to 42.18 mh in 1991 and sugarcane acreage has increased from 1.71 mh in 1950 to 3.41 mh in 1991. During these developments health impact assessment (HIA) in the environment impact assessment (EIA) has been largely neglected. This has created tremendous opportunities for the mosquito vectors to breed uninterruptedly and invade new regions thus increasing the area of their distribution and also the duration of transmission.

1.7 In urban areas malaria control is based on larval control. Urban population was 62.40 million and towns 2843 in 1951. By 1991 the population increased to 217.17 million and towns 4689. In most urban areas 30-40% population lives in hutments and in the peri-urban areas. In these settlements water supply and drainage are both inadequate resulting in unhygienic living. Peri-urban ecotype has emerged as a new malaria paradigm

(Sharma et.al. 1994). Malaria control in urban areas requires the implementation of legislative measures (Covell, 1928). This is lacking except in a few towns e.g., Bombay.

1.8 A study of the economic loss due to malaria and its future trends revealed that malaria in India was responsible for economic losses between US $ 0.5 to 1.0 billion annually. The study also brought out that malaria situation is likely to deteriorate further due to environmental changes creating enormous potential favoring the proliferation of disease vectors (Sharma, 1995). Investments in malaria control therefore make economic sense and provide health equity.

Present status of NMEP implementation and constraints

Health is a state subject and Central Government provides assistance to the states for implementing various national health programmes.

Pattern of Central Assistance to states for malaria control

Central Assistance requuired to be provided to the States is to be processed through EXPENDITURE FINANCE COMMITTEE and Planning Commission of GOI and finally approved by the Cabinet.As per the approved pattern the total expenditure on malaria control is borne by centre and state governments on 50:50 sharing basis, except 7 North Eastern States of Assam,Arunachal Pradesh, Nagaland, Manipur, Meghalaya, Mizoram and Tripura where hundred Percent central Assistance is provided to the States w.e.f. 1.12.94. In addition U.T.'s are also covered by 100% Central Assistance. As per the Planning Commission guidelines for

VIIIth Plan the salary component of regular staff including MPW would be Nonplan responsibility ofthe States w.e.f 1.4.90.

Pattern of logistics for malaria control :

As per the approved pattern the material and equipments required for the programme would be procured by the centre and States as follows:

a) Centre - insecticides i.e. DDT total, BHC and mlathion for UTs
Pyrethrum extract for urban areas

Drugs: all drugs

Larvicides: except MLO.

In addition BHC and Malathion maybe procured for some states as special case on request.However BHC is to be phased out by 1997.

b) States 1) BHC and Malathion total requirement

2) Vehicles

3) microscopes and other lab. articles

4) sprayers and spares and related items

5) MLO for urban areas

Constraints in the implementation of malaria control

The implementation of malaria control measures in the states are presently facing many constrains like inadequacy of funds needed for payment of operational cost of insecticidal spray and purchase of material and equipments including vehicles required for supervision of malaria control activities.Details of the hindrances are given in Annexxure.

2. INTEGRATED MALARIA CONTROL

Integrated malaria control strategy drafted for adoption by the NMEP basically derives strength from the Alma Ata declaration (WHO,1978) and the Global Malaria Control Strategy (WHO,1993). In both these major health policy declarations Government of India have been the signatory and therefore committed to adopt. Reference is also made to the malaria meeting on the Implementation of the Revised Malaria Control Strategy held in New Delhi (SEARO-WHO, 1993), in which detail guidelines for the adoption of malaria control strategy were provided. A scrutiny of the proposed strategy would reveal that conceptually and operationally there is no deviation from the guidelines and recommendations contained in this document (objectives, mechanism, indicators, monitoring etc.), exception being minor changes to suite the health infrastructure.

Health delivery in the country is through the primary health care system and all vertical health programmes have been made

horizontal and merged with the PHC. Furthermore Government of India is committed for Panchayat Raj and many states have fully adopted and re-organized the governing system, while others are in transition. In Panchayat Raj, village Panchayat would be the smallest administrative unit governed by the elected representatives. In the drafting of integrated malaria control strategy involvement of village Panchayats has been ensured and malaria control has been decentralized to be implemented by the Zila Parishad.

2.1 Objectives: (i) Implementation of the revised malaria control strategy by 1997, and (ii) reduction by 25 percent of the malaria specific mortality rate by the year 2000, particularly in high risk groups, as compared to 1995.

2.2 Mechanism: Through political support, primary health care approach, capacity building, community participation, involvement of non-health sectors, decentralization of decision making, and research support.

2.3 Indicators: The following epidemiological and operational indicators would be used to minor the programme.

2.3.1 Epidemiological indicators: (a) Morbidity indicators: Patients with acute febrile illness: patients with clinically-diagnosed malaria; children (0-9 years) with enlarged spleen; clinically-diagnosed malaria cases confirmed by laboratory: severe, complicated and cerebral malaria cases referred to hospital; children, pregnant women and other high risk groups with clinically diagnosed malaria and treatment failure malaria

cases; b) Mortality indicators: Deaths due to clinically-diagnosed malaria and a percentage among total deaths, deaths due to confirmed malaria cases among total deaths in health facilities, and case-fatality rate (confirmed cases) by age and sex, in health facilities; and c) Proportion of P.falciparum cases among the total number of malaria cases confirmed by laboratory, proportion of P.falciparum drug failures, population in endemic-prone areas and number of clinical and confirmed (by species) malaria cases, population in areas with P. falciparum drug resistance, Population in areas with vector resistance to insecticides, number of foci with prominent P.falciparum incidence/ prevalence, with recorded mortality, parasite rate, parasite formula

2.3.2 Operational indicators: Input indicators: Health institutions with antimalarial drugs available regularly throughout the year, staff trained in disease management, health facilities with microscopes and laboratory technicians; non-governmental facilities with antimalarial drugs, ratio of laboratories with microscopes and technicians to unit population, specialized malaria workers, and annual consumption of antimalarials and current stocks. Process indicators: Current vacant posts at health care facilities, mortality review of severe malaria cases per institution, review of malaria incidence. Outcome indicators: Reduction in the number of deaths (clinical and diagnosed), reduction in case-fatality rate in hospitals, reduction in the number of cases (clinical and diagnosed), spleen rate and parasite rate; improvement in the

quality of case management in: (a) reduction in period of febrile illness, (b) increase in the number of adequately trained staff and health care infrastructure. Input: population targeted for vector control measures, personal protection measures, chemoprophylaxis, number of trained staff available for disease prevention activities, spraying equipment and insecticides available, provision of transport, stock of drugs and insecticides to meet emergency situation. Output; population protected by planned anti vector measures, personal protection measures, chemoprophylaxis; population protected by emergency control measures; Impact; reduction in morbidity, mortality, case fatality, number of P. falciparum cases, parasite rate, spleen rate and average enlarged spleen, number of confirmed malaria cases in epidemic-prone and project areas, number of P. falciparum foci with reduction or increase of incidence/prevalence; indicators presented by high-risk groups, where appropriate.

3. METHODOLOGY

3.1 Technical Elements: Despite the problem of chloroquine resistance malaria is a treatable disease and morbidity and mortality due to malaria can be reduced to a bare minimum with access to early diagnosis and prompt treatment. Also malaria control has been demonstrated in many endemic countries to be an achievable goal with proper planning and targeted interventions. WHO (1993) stated that protection from malaria is a fundamental right of all populations at risk of the disease. It is therefore

imperative that in a democratic society committed to equity and social justice malaria control is given priority particularly in backward and high risk areas. Revised malaria control strategy precisely envisages this with World Bank financing. In the implementation of the revised malaria control, primary considerations would be the cost-effectiveness of interventions; sustainability; promotion of indigenous and locally available technologies; decentralization of decision making; malaria control through Zila Parishad; involvement of Panchayats; community participation through improved information, education and communication; intersectoral coordination; periodical reviews; and incorporation of results of research to improve the field operations. The renewed attack on malaria takes this in to cognizance to organize malaria control based on the four technical elements of the Global Malaria Control Strategy of the World Health Organization, namely:

(1) to provide early diagnosis and prompt treatment;

(2) to plan and implement selective and sustainable preventive measures, including vector control;

(3) to detect early, contain or prevent epidemics; and

(4) to strengthen local capacities in basic and applied research to permit and promote the regular assessment of a country's malaria situation, in particular the ecological, social and economic determinants of the disease.

3.2 Identification of areas for intensified field

operations: Epidemiological investigations have revealed that some areas of the country have high P. falciparum transmission. In these areas deaths due to malaria may be occurring but not recorded by the NMEP due to lack of slide examination of the deceased. Therefore figures of malarial deaths are not reliable. In these areas P. falciparum has also developed various levels of resistance to chloroquine. It was therefore decided to intensify malaria control in these areas. PHCs showing > 30% Pf were selected for intensified malaria control through the WB assistance. These areas comprise of 61.2 million population. Field operations would be required in 1045 PHCs in 97 districts. Epidemiological indices of malaria situation in India and population under consideration of intensified malaria control in Pf dominant areas are given in Table 2. Furthermore rising trends in the transmission of malaria are being reported from the urban areas. The rise in cases of P. falciparum and problem of drug resistance is also being reported from the urban areas. Due to the lack of ACD and a well developed private sector, epidemiological data from the urban areas is inadequate. It was therefore decided to select urban areas reporting >10 SPR. There are 19 towns with a total population of 17.0 million. Epidemiological data with the requirement of supplies to control malaria are given in Table 3.

3.3 Guidelines in the preparation of revised malaria control strategy:

3.3.1 No additional staff would be recruited for the revised

malaria control strategy other than those already committed and planned by the central and state governments. WB assistance and any special input to facilitate the delivery of malaria control would be done by involving the communities, private sector, NGOs, voluntary agencies, assigning responsibility to other sectors, sharing of cost with other departments through intersectoral coordination at the highest level.

3.3.2 Cost calculations and their relative impact on malaria transmission of each malaria control activity would become obligatory at the state level to ensure that no extraneous and avoidable expenditure is incurred and the most effective and low cost methods are deployed to meet the objectives of the revised malaria control strategy.

3.3.3 Sustainability of field operations in malaria control operations is an important consideration in view of the yearly cost escalations, difficulties in the timely procurement of supplies, time limited effectiveness of the spraying strategy, operational problems and technical obstacles. Experience in the last decade is a testimony to the fact that almost total dependence on insecticidal spraying resulted in diminishing returns and malaria control status maintainable by the PHC system has become unattainable. Unfortunately shortages resulted in the compromise with spray targets. All areas with API 2 and above could not be sprayed and cut of point for spraying was determined on the availability of insecticides instead. The basic reproduction rate of malaria in most areas of the country is high

EPIDEMIOLOGICAL PARAMETERS FOR P.F.PREDOMINANT PHCs

STATE - ANDHRA PRADESH

1 S.NO	2 NAME OF THE DISTT.	3 NO.OF P.F. PREDOMINANT PHCs	4 POPULATION (In 000)	5 YEAR	6 ABER	7 API	8 SPR	9 SFR	10 AFI	11 %Pf
1.	SRIKAKULAM	3		1991	26.18	10.19	3.56	3.20	9.16	90.03
				1992	26.97	14.76	5.47	4.47	12.05	81.83
				1993	20.62	14.22	4.98	3.83	10.96	76.88
			147	1994	23.10	14.51	4.90	3.62	10.73	74.00
2.	VIJAYANAGARAM	7		1991	34.76	4.92	1.25	1.18	4.64	94.48
				1992	31.35	5.45	1.48	1.30	4.78	87.82
				1993	30.83	4.82	1.28	1.08	4.07	84.42
			318	1994	28.64	4.98	1.31	1.13	4.29	86.05
3.	VISHAKAPATNAM	13		1991	36.86	19.30	4.04	3.21	15.33	79.47
				1992	36.52	18.39	8.81	2.72	13.16	71.47
				1993	34.10	15.7	3.71	2.69	11.40	72.58
			510	1994	37.79	21.09	4.47	3.28	12.98	73.54
4.	EAST GODAVARI	8		1991	53.42	25.26	3.94	3.54	22.80	90.14
				1992	51.56	18.71	3.26	2.93	16.80	89.94
				1993	48.44	19.49	3.49	3.17	17.69	90.94
			214	1994	55.73	29.63	4.27	3.93	27.28	92.17
5.	WEST GODAVARI	2		1991	29.99	18.86	4.86	3.95	15.12	81.36
				1992	24.77	5.07	2.04	1.74	4.33	85.50
				1993	23.78	1.75	0.06	0.54	1.50	84.76
			122	1994	22.36	2.0	0.71	0.52	1.47	72.76
6.	KURNOOL	2		1991	19.98	3.10	1.26	0.35	0.87	27.85
				1992	20.62	2.71	1.24	0.65	1.43	52.38
				1993	15.74	2.29	1.35	0.32	0.55	23.95
			74	1994	10.71	0.97	0.70	0.28	0.31	40.35
7.	MAHABUBNAGAR	2		1991	24.47	2.31	0.93	0.26	0.67	28.83
				1992	32.69	1.48	0.41	0.11	0.40	26.47
				1993	31.38	1.19	0.31	0.17	0.67	56.45
			52	1994	26.35	0.61	0.21	0.13	0.38	62.50

8.	ADILABAD	13			1991	21.42	5.96	2.76	1.69	3.64	61.27
					1992	17.46	4.77	2.69	1.43	2.53	53.14
					1993	14.14	4.60	3.33	2.26	3.26	67.88
				482	1994	10.83	6.28	2.34	1.53	4.13	65.75
9.	WARANGAL	7			1991	20.16	3.18	1.33	0.61	1.18	54.51
					1992	22.15	3.50	1.44	0.87	2.11	60.33
					1993	20.66	3.67	1.60	0.67	1.55	42.26
				235	1994	18.83	4.83	2.23	1.15	2.49	51.67
10.	KHAMMAM	22			1991	23.59	11.48	4.49	3.65	9.34	81.40
					1992	23.68	7.38	2.80	2.08	5.49	74.35
					1993	22.70	6.89	2.70	2.39	6.11	88.60
				566	1994	22.75	6.05	2.48	2.03	4.97	82.01
	TOTAL FOR 79 PHCs.				1991	29.26	11.34	3.33	2.66	9.07	80.04
					1992	27.88	7.04	2.90	2.17	7.04	74.94
					1993	26.08	8.60	2.81	2.19	6.70	77.83
				2719	1994	29.05	10.56	3.09	2.40	8.20	77.61

EPIDEMIOLOGICAL PARAMETERS FOR P.F.PREDEOMINANT PHCs

STATE - BIHAR

S.NO.	NAME OF THE DISTT.	NO.OF P.F. PREDOMINANT PHCs	POPULATION (IN 000)	YEAR	ABER	API	SPR	SFR	AFI	%Pf
1.	RANCHI	20		1991	3.02	1.22	4.05	3.02	0.91	74.67
				1992	2.39	1.00	4.21	2.86	0.68	67.98
				1993	1.25	0.64	5.16	4.14	0.76	80.32
			2389	1994						
2.	GUMLA	18		1991	9.61	19.60	16.23	14.75	14.18	90.85
				1992	7.74	14.14	18.26	15.72	12.17	86.08
				1993	7.46	14.20	18.30	16.41	12.65	89.69
			1214	1994						
3.	LOHARDAGA	5		1991	6.17	5.08	8.23	5.60	3.46	60.10
				1993	2.76	2.18	7.90	3.91	1.41	49.55
			320	1994						
4.	EAST SINGHBUM	9		1991	3.33	2.10	6.30	5.96	1.98	94.59
				1992	3.75	2.82	7.52	6.73	2.56	89.49
				1993	3.65	4.19	11.39	10.09	3.71	88.58
			1729	1994						
5.	WEST SINGHBUM	23		1991	5.11	4.04	7.90	6.99	4.18	88.59
				1992	5.59	4.96	8.87	7.51	4.27	84.69
				1993	5.36	4.82	8.99	7.73	4.15	85.99
			1937	1994						
6.	PALAMU	7		1991	7.18	8.08	11.24	7.93	5.69	70.52
				1992	6.92	8.21	11.85	0.11	6.31	76.90
				1993	9.38	10.65	11.37	8.55	8.02	75.25
			524	1994						
7.	GARHWA	1		1991	5.63	1.80	3.20	1.27	0.71	39.75
				1992	4.24	1.75	4.13	3.28	1.40	79.51
				1993	7.73	4.46	5.60	4.09	3.14	72.98
			50	1994						
8.	DUMKA	10		1991	5.23	2.47	4.72	0.59	0.31	12.60
				1992	4.34	2.21	5.10	0.34	0.14	6.71
				1993	3.09	2.27	5.29	0.23	0.10	4.44
			1074	1994						

9.	SAHERGANJ	13			1991	4.02	0.41	1.02	0.07	0.03	7.55
					1992	2.71	0.23	0.85	0.36	0.10	43.26
					1993	3.07	1.16	3.78	0.48	0.14	12.65
				1403	1994						
10.	GODDA	2			1991	7.68	0.52	0.67	0.28	0.22	42.50
					1992	4.63	0.90	1.95	0.53	0.24	27.46
					1993	3.77	2.25	5.98	3.31	1.25	55.40
				163	1994						
	Total No.of PHCs 108				1991						
					1992						
					1993						
			Total Population	10803	1994						

EPIDEMIOLOGICAL PARAMETERS FOR P.F.PREDOMINANT PHC

STATE - GUJARAT

S.NO.	NAME OF THE DISTT.	NO.OF P.F. PREDOMINANT PHCs	POPULATION (In 000)	YEAR	ABER	API	SPR	SFR	AFI	%Pf
1.	Dangs	7		1991	15.5	19.6	12.7	2.1	3.3	17.0
				1992	19.2	17.8	9.3	1.6	3.1	17.3
				1993	20.7	14.5	7.0	1.2	2.5	16.8
			146	1994	21.7	10.0	4.5	0.6	1.3	13.1
2.	Surat	56		1991	11.6	10.8	9.3	4.0	4.69	43.3
				1992	13.0	7.6	5.8	2.4	3.13	41.2
				1993	13.5	9.2	6.7	2.2	2.99	32.5
			1808	1994	11.6	5.6	4.8	1.5	1.84	32.7
3.	Bharuch	26		1991	22.5	21.5	9.6	2.29	5.65	23.9
				1992	23.5	19.8	8.4	1.57	3.70	18.7
				1993	19.8	12.9	6.5	1.71	3.38	26.1
			679	1994	17.2	11.4	6.6	0.61	0.93	13.9
4.	Valsad	44		1991	14.6	8.2	5.6	1.4	2.2	26.5
				1992	16.9	6.5	3.8	1.1	2.0	31.0
				1993	18.2	7.5	4.1	1.1	1.9	27.2
			1702	1994	15.6	4.4	2.8	0.6	0.5	21.4
5.	Baroda	21		1991	20.1	17.7	8.8	1.7	4.0	22.5
				1992	21.0	13.0	5.8	1.2	2.7	20.9
				1993	19.0	6.8	8.8	1.0	1.8	22.5
			705	1994	16.9	5.4	3.2	0.7	1.0	21.4
6.	Panchmahals	58		1991	17.6	18.6	10.5	2.1	3.9	20.7
				1992	15.5	14.8	9.5	1.8	2.9	19.9
				1993	19.1	16.8	8.8	1.9	3.7	22.5
			2043	1994	13.9	9.2	6.6	1.2	1.6	15.3
7.	Sabarkantha	19		1991	28.4	8.9	3.8	0.7	2.1	23.1
				1992	34.4	16.5	4.8	1.6	5.7	20.9
				1993	38.6	19.7	5.1	1.4	5.4	27.4
			574	1994	31.3	11.1	3.5	0.5	1.8	18.6

8.	Banaskantha	8	206	1991	18.8	6.5	3.5	0.4	0.8	11.7
				1992	19.8	3.2	1.6	0.4	0.9	26.4
				1994	18.0	1.1	0.6	0.2	0.3	27.0
				1994	19.7	2.7	1.4	0.4	0.8	32.2
	Total for 239 PHCs		7863	1991	17.2	14.1	8.0	2.1	3.6	25.9
				1992	19.0	11.6	6.1	1.6	3.0	26.2
				1993	19.2	11.5	6.0	1.6	3.1	26.2
				1994	16.2	6.8	4.2	0.9	1.5	20.7

EPIDEMIOLOGICAL PARAMETERS FOR P.F. PREDOMINANT PHCs

STATE - MAHARASHTRA

S.NO	NAME OF THE DISTT.	NO. OF P.F. PREDOMINANT PHCs	POPULATION (In 000)	YEAR	ABER	API	SPR	SFR	AFI	%Pf.
1.	RAIGAD	3		1991						
				1992	25.7	12.7	5.0	1.3	3.4	26.6
				1993	22.2	12.5	5.6	1.1	2.5	20.0
			43	1994	24.7	10.1	4.1	1.7	4.2	42.2
2.	THANE	46		1991						
				1992	23.5	17.6	7.5	2.7	6.4	36.2
				1993	24.2	19.7	8.1	3.0	7.2	36.7
			975	1994	28.6	17.3	6.1	2.8	7.8	45.4
3.	AHMEDNAGAR (SANGAMNER)	10		1991						
				1992	23.4	0.9	0.4	0.1	0.2	22.6
				1993	19.5	0.6	0.3	0.1	0.1	21.4
			229	1994	22.1	0.7	0.3	0.1	0.1	17.3
4.	DHULE	42		1991						
				1992	16.0	2.7	1.7	0.9	1.4	52.5
				1993	13.8	2.6	1.9	0.9	1.2	48.9
			1136	1994	15.4	3.1	2.0	1.0	1.5	48.2
5.	NASIK	40		1991						
				1992	16.0	5.1	3.2	1.4	2.2	44.3
				1993	13.7	8.3	6.1	2.2	3.0	35.8
			920	1994	19.1	9.1	4.8	1.7	3.2	35.0

6.	JALGAON	2		1991						
				1992	32.8	2.8	0.9	0.4	1.3	48.5
				1993	28.6	11.7	4.1	2.3	6.5	56.0
			34	1994	25.2	9.5	3.8	1.7	4.1	44.0
7.	PUNE	7		1991						
				1992	14.2	1.7	3.3	1.7	0.9	49.6
				1993	17.1	1.8	1.4	0.6	0.6	24.8
			142	1994	14.0	2.0	1.4	0.1	0.7	34.8
8.	NANDED	8		1991						
				1992	13.8	0.9	0.6	0.1	0.4	17.7
				1993	16.5	3.9	2.4	1.1	1.7	44.3
			260	1994	23.8	3.2	1.3	0.4	0.9	29.9
9.	AMRAVATI	9		1991						
				1992	20.7	6.2	3.0	0.7	1.5	23.6
				1993	21.5	10.5	4.9	1.4	3.9	27.5
			159	1994	23.6	9.1	3.9	1.0	2.5	24.8
10.	YEOTMAL	19		1991						
				1992	16.4	7.1	4.3	0.7	1.1	16.2
				1993	15.5	9.2	5.9	0.8	1.2	13.0
			490	1994	19.6	12.4	6.3	1.6	3.1	25.0
11.	BHANDARA	19		1991						
				1992	19.5	1.4	0.7	0.3	0.6	45.6
				1993	20.6	2.6	1.1	0.8	1.8	69.6
			421	1994	26.8	4.1	1.4	0.2	0.6	15.5
12.	CHANDRAPUR	8		1991						
				1992	29.8	9.5	3.2	1.7	5.1	53.2
				1993	26.7	9.2	3.5	1.8	4.7	51.7
			186	1994	23.8	8.1	11.8	1.5	3.8	12.6

13.	GADCHIROLI	26		1991						
				1992	34.3	32.7	9.5	7.7	26.3	80.4
				1993	40.6	30.8	7.6	6.3	25.5	82.9
			414	1994	46.2	24.1	5.2	3.4	15.5	64.2
14.	NAGPUR	4		1991						
				1992	35.8	10.7	3.0	0.6	2.3	12.5
				1993	23.7	7.6	3.2	0.5	1.2	15.2
			91	1994	26.3	12.3	4.7	0.9	2.4	19.4
TOTAL FOR 246 PHCs				1991						
				1992	20.0	8.7	4.4	2.2	4.3	49.7
				1993	20.1	9.9	4.9	2.3	4.5	45.8
			5500	1994	23.6	9.1	3.9	1.3	3.8	32.6

EPIDEMIOLOGICAL PARAMETERS FOR P.F. PREDOMINANT PHCs

STATE - MADHYA PRADESH

NAME OF THE DISTT.	NO. OF P.F. PREDOMINANT PHCs	YEAR	POPULATION (In 000)	BSE	TOTAL +VE	TOTAL Pf	ABER	API	SPR	SFR	API	IPf
Dhar	12	1991	1127	132661	3985	564	11.77	3.54	3.00	0.43	0.50	14.15
		1992	1174	151893	3576	438	12.93	3.05	2.35	0.29	0.37	12.25
		1993	1205	180586	5880	997	14.98	4.87	3.26	0.55	0.82	16.96
		1994	1231	173168	5239	792	14.06	4.26	3.03	0.46	0.64	15.12
Jhabua	12	1991	1138	149471	10687	5824	13.13	9.39	7.15	3.90	5.11	54.50
		1992	1167	170455	9888	5399	14.60	8.47	5.80	3.17	4.62	54.60
		1993	1269	196670	9920	7151	15.04	7.81	5.04	3.64	5.64	72.09
		1994	1293	164082	7561	4171	12.69	5.84	4.61	2.54	3.22	55.16
Barwani	14	1991	1679	137114	4221	1055	8.16	2.51	3.08	0.77	0.63	24.99
		1992	1698	137976	2344	455	8.12	1.38	1.70	0.33	0.26	19.41
		1993	1709	227483	2305	458	13.31	1.34	1.01	0.20	0.27	19.87
		1994	1755	271374	4873	586	15.46	2.77	1.80	0.22	0.33	12.03
Khandwa	2	1991	301	45145	723	346	14.99	2.40	1.60	0.77	1.14	47.86
		1992	301	57637	1574	771	19.14	5.22	2.73	1.34	2.56	48.98
		1993	307	52879	1761	424	17.22	5.73	3.33	0.80	1.38	24.08
		1994	314	59663	2613	938	19.00	8.32	4.38	1.57	2.98	35.90
Ratlam	2	1991	166	20738	167	140	12.49	1.00	0.81	0.68	0.84	83.83
		1992	170	22846	171	133	13.43	1.00	0.75	0.58	0.78	77.78
		1993	174	25411	282	213	14.60	1.62	1.11	0.84	1.22	75.53
		1994	179	17467	353	265	9.75	1.97	2.02	1.52	1.48	75.07
Hoshangabad	1	1991	109	11608	71	15	10.65	0.65	0.61	0.13	0.14	21.13
		1992	111	13349	24	8	12.02	0.21	0.18	0.06	0.70	33.33
		1993	114	12530	94	17	10.99	0.82	0.75	0.14	0.15	18.09
		1994	115	11456	82	30	9.96	0.71	0.72	0.26	0.26	36.59

Betul	7	1991	774	95451	670	130	12.33	0.86	0.70	0.14	0.17	19.40
		1992	786	98360	308	89	12.51	0.91	0.31	0.09	0.11	28.90
		1993	803	102385	351	191	12.75	0.43	0.34	0.19	0.24	54.42
		1994	827	101934	648	124	12.32	0.78	0.64	0.12	0.15	19.14
Morena	1	1991	67	6327	52	43	9.44	0.78	0.82	0.68	0.64	82.69
		1992	69	12211	41	19	17.69	0.59	0.34	0.16	0.27	46.34
		1993	71	8566	56	44	12.06	0.79	0.65	0.51	0.62	78.57
		1994	72	6432	52	39	8.93	0.72	0.81	0.61	0.54	75.00
Sidhi	1	1991	59	4591	3	1	7.78	0.50	0.07	0.02	0.01	33.33
		1992	55	7667	336	154	13.94	6.10	4.38	2.01	2.80	45.83
		1993	56	7135	161	24	12.74	2.87	2.26	0.34	0.42	14.91
		1994	58	6704	145	12	11.55	2.50	2.16	0.18	0.20	8.28
Shahdol	9	1991	1240	110328	1220	322	8.89	0.98	1.11	0.29	0.25	26.39
		1992	1988	115703	2377	491	5.82	1.19	2.05	0.42	0.25	20.66
		1993	1321	118658	3990	1173	8.98	3.02	3.36	0.99	0.88	29.40
		1994	1354	123609	3325	751	9.12	2.45	2.69	0.61	0.55	22.59
Jabalpur	1	1991	98	8314	290	235	8.48	2.95	3.49	2.83	2.39	81.03
		1992	99	7612	328	273	7.68	3.31	4.31	3.59	2.76	83.23
		1993	97	11611	495	441	11.97	5.10	4.26	3.80	4.55	89.09
		1994	100	10368	238	195	10.36	2.38	2.30	1.88	1.95	81.93
Chhindwara	4	1991	370	45359	314	118	12.25	0.85	0.69	0.26	0.31	37.58
		1992	376	51073	1122	660	13.58	2.98	2.20	1.29	1.75	58.82
		1993	387	55964	563	333	14.46	1.45	1.01	0.60	0.86	59.15
		1994	395	51538	439	276	13.04	1.11	0.85	0.54	0.69	62.87
Balaghat	3	1991	289	56365	3437	897	19.50	11.89	6.10	1.59	3.10	26.10
		1992	295	51808	5240	1464	17.56	17.76	10.11	2.83	4.96	27.94
		1993	303	51035	6812	974	16.84	22.48	13.35	1.91	3.21	14.30
		1994	311	44575	7409	1192	14.33	23.82	16.62	2.67	3.83	16.09
Mandla	16	1991	1318	212444	14191	7668	16.11	10.76	6.68	3.61	5.82	54.03
		1992	1322	256090	15122	7347	19.37	11.43	5.90	2.87	5.56	48.58
		1993	1352	257979	21135	8269	19.08	15.63	8.19	3.21	6.12	39.12
		1994	1390	180156	14359	5158	12.96	10.33	7.97	2.86	3.71	35.92

Bilaspur	3	1991	238	34494	2280	2048	14.48	9.58	8.61	5.93	8.60	89.74
		1992	230	34153	2455	2334	14.84	10.67	7.19	6.83	10.14	95.07
		1993	167	36859	2223	2116	22.07	13.31	6.03	5.74	12.67	95.19
		1994	170	35810	2508	2378	21.06	14.75	7.00	6.64	13.98	94.82
Janjgir	5	1991	763	96035	11053	10316	12.58	14.48	11.51	10.74	13.52	93.33
		1992	763	88409	8202	7040	11.58	10.74	9.28	7.96	9.22	85.83
		1993	780	88955	6682	5895	11.40	8.56	7.51	6.63	7.55	88.22
		1994	802	87572	3691	2991	10.91	4.60	4.21	3.42	3.72	81.03
Ambikapur	24	1991	2083	286479	13936	11113	13.75	6.89	4.86	3.88	5.34	79.74
		1992	2138	234338	17335	13324	10.86	8.11	7.40	5.69	8.23	76.86
		1993	2095	245243	18114	14706	11.70	8.65	7.39	6.00	7.02	81.19
		1994	2242	262324	26128	19385	11.70	11.65	9.96	7.39	8.65	74.19
Raigarh	13	1991	1000	180872	33524	25486	18.08	33.52	18.53	14.09	25.48	76.02
		1992	129	179918	34330	25841	13.94	26.12	19.08	14.36	20.31	75.27
		1993	144	141742	18673	15794	98.43	12.96	13.17	11.14	10.96	84.58
		1994	908	166721	22996	15784	18.36	25.32	13.79	9.47	17.38	68.64
Chaple	1	1991	116	11685	120	88	10.07	1.03	1.03	0.75	0.76	73.33
		1992	117	9912	115	79	8.47	0.98	1.16	0.80	0.68	68.70
		1993	0	7116	80	66	0.00	0.00	1.12	0.93	0.00	82.50
		1994	0	10813	83	76	0.00	0.00	0.77	0.70	0.00	91.57
Mahasamund	1	1991	0	8344	103	61	0.00	0.00	1.23	0.73	0.00	59.22
		1992	0	10222	277	183	0.00	0.00	2.71	1.79	0.00	66.06
		1993	93	6184	117	81	6.64	1.25	1.89	1.31	0.87	69.23
		1994	95	7650	71	30	8.05	0.74	0.93	0.39	0.32	42.25
Gariyaband	3	1991	0	37914	1580	780	0.00	0.00	4.17	2.06	0.00	49.37
		1992	314	42307	2557	1508	13.47	8.14	6.04	3.56	4.80	58.98
		1993	336	43503	2421	429	12.94	7.20	5.57	0.99	1.28	17.72
		1994	344	41700	3504	1960	12.12	10.18	8.40	4.70	5.69	55.94
Durg	1	1991	159	8800	221	160	55.35	1.38	2.51	1.82	1.00	72.40
		1992	162	15683	1440	659	9.68	8.89	9.18	4.20	4.06	45.76
		1993	167	10440	144	35	6.25	0.86	1.38	0.34	0.20	24.31
		1994	170	15812	212	51	9.30	1.25	1.34	0.32	0.30	24.05

Rajnandgaon	3	1991	228	39117	2081	580	17.15	9.13	5.32	1.48	2.54	27.87
		1992	0	1834	1834	696	0.00	0.00	100.00	37.95	0.00	37.95
		1993	230	32985	1148	408	14.34	4.99	3.48	1.24	1.77	35.54
		1994	236	38071	2957	370	16.13	12.53	7.77	0.97	1.56	12.51
Bastar	20	1991	1191	288480	28588	20392	24.22	24.00	9.91	7.07	17.12	71.33
		1992	886	244040	21198	18087	27.54	23.93	8.69	7.41	20.14	85.32
		1993	1208	257666	16921	13687	21.33	14.01	6.57	5.31	11.33	80.89
		1994	1218	291762	15009	12177	23.95	12.32	5.14	4.17	99.97	81.13
Kanker	17	1991	1051	287978	47611	41633	27.40	45.30	16.53	14.46	39.61	87.44
		1992	266	218267	36416	32773	82.05	13.69	16.68	15.02	12.32	90.00
		1993	671	230599	34599	29789	34.36	51.56	15.00	12.92	44.39	86.10
		1994	825	228511	32984	26621	27.69	39.98	14.43	11.65	32.26	80.71
Seoni	5	1991	517	74656	1847	590	14.44	3.57	2.47	0.79	1.14	31.94
		1992	359	84748	2785	314	23.60	7.76	3.29	0.37	0.87	11.27
		1993	524	67158	4499	2026	12.81	8.59	6.70	3.02	3.86	45.03
		1994	547	70148	2495	1082	12.82	4.56	3.56	1.54	1.97	43.37
		1991	16081	2390770	182975	130603	37.35	0.19	120.59	79.880	0.13	1418.7
		1992	14975	2318511	171395	120539	40.45	0.18	233.82	124.96	0.11	1403.7
		1993	15583	2477342	159426	105741	44.72	0.2	123.74	73.246	0.12	1396.0
Total No. of PHCs	181	1994	16951	2479420	159974	97434	34.56	0.2	127.89	67.403	0.2	1301.8

			1993	222744	44627	7258	6908	20.04	32.58	16.26	15.61	31.28	96.00
			1994	243745	54712	10614	9334	22.45	43.55	19.40	18.16	40.76	93.59
A1..N7													
8.	NAWAPADA	5	1991	453004	71420	10672	7362	15.77	23.56	23.26	10.31	16.25	68.98
			1992	453004	66940	10852	8108	14.78	23.96	16.21	12.11	17.90	74.71
			1993	490074	49287	7701	5245	10.06	15.71	15.62	10.64	10.70	68.11
			1994	490074	48734	9144	6536	9.94	18.66	18.76	13.41	13.34	71.48
9.	KEONJHAR	11	1991	994013	330973	54218	51605	33.30	54.54	16.38	15.59	51.92	95.18
			1992	1005815	302073	49972	47820	30.03	49.68	16.54	15.83	47.54	95.69
			1993	930195	280632	49079	46292	30.17	52.76	17.49	16.50	49.77	94.32
			1994	2343101	296842	49508	43227	12.67	21.13	16.68	14.56	18.45	87.31
10.	BARGARH	4	1991	298970	19751	424	278	6.61	1.42	2.15	1.41	0.93	65.57
			1992	298970	21005	1187	1028	7.03	3.97	5.65	4.89	3.44	86.60
			1993	310094	17728	586	421	5.72	1.89	3.31	2.37	1.36	71.84
			1994	310094	17638	696		5.69	2.24	3.95	0.00	0.00	0.00
11.	BELANGIR	6	1991	455000	107953	20214	14481	23.73	44.43	18.72	13.41	31.83	71.64
			1992	460173	65992	7786	5633	14.34	16.92	11.80	8.54	12.24	72.35
			1993	492194	53050	4859	13769	10.78	9.87	9.16	25.95	27.97	283.37
			1994	492194	53025	4925	3897	10.77	10.01	9.29	7.35	7.92	79.13
12.	DHENKANAL	1	1991	83978	10598	393	139	12.62	4.68	3.71	1.31	1.66	35.37
			1992	83978	9723	669	318	11.58	7.97	6.88	3.27	3.79	47.53
			1993	83978	6853	524	249	8.16	6.24	7.65	3.63	2.97	47.52
			1994	86781	8207	878	753	9.46	10.12	10.70	9.18	8.68	85.76
13.	KALAHANDI	7	1991	561039	86977	7658	5364	15.50	13.65	8.80	6.17	9.56	70.04
			1992	561039	94301	15973	5939	16.81	28.47	16.94	6.30	10.59	37.18
			1993	561039	81169	6880	4590	14.47	12.26	8.48	5.65	8.18	66.72
			1994	561039	67774	5417	3296	12.08	9.66	7.99	4.86	5.87	60.85
14.	JAJPUR	2	1991	188543	21895	2746	1336	11.61	14.56	12.54	6.10	7.09	48.65
			1992	189723	22149	1730	919	11.67	9.12	7.81	4.15	4.84	53.12
			1993	197396	18089	1488	843	9.16	7.54	8.23	4.66	4.27	56.65
			1994	197396	17914	1876	1195	9.08	9.50	10.47	6.67	6.05	63.70
15.	SUNDERGARH	17	1991	1631436	295877	49464	44501	18.14	30.32	16.72	15.04	27.28	89.97
			1992	1567674	280102	42039	38970	17.87	26.82	15.01	13.91	24.86	92.70

A1..N7

EPDEMIOLOGICAL PARAMETERS FOR P.F. PREDOMINANT PHCs
STATE - ORISSA

S.NO.	NAME OF THE DISTRICT	NO. OF P.F. PREDOMINANT PHCs	YEAR	POPULATION (IN 000)	B.S.E	TOTAL +VE	TOTAL Pf	ABER	API	SPR	SFR	AFI	%Pf
1.	BALASORE	1.	1991	96151	23799	1755	1426	24.75	18.2	7.4	6	14.83	81.25
			1992	98453	16491	1312	1104	16.75	13.3	8	6.7	11.21	84.15
			1993	98182	15625	1066	1008	15.91	10.8	6.8	6.4	10.27	94.56
			1994	100440	11936	817	768	11.88	8.1	6.8	6.4	7.65	94.00
2.	GANJAM	1	1991	119283	12651	833	784	10.61	6.98	6.58	6.19	6.57	94.12
			1992	119283	12270	948	906	10.29	7.9	8.33	7.96	7.60	95.57
			1993	126356	8311	653	639	6.58	4.9	78	7.6	5.06	97.86
			1994	135027	8486	743	715	6.28	5.5	8.7	8.4	5.30	96.23
3.	GAJAPATI	6	1991	319839	92389	11905	11036	28.89	37.22	12.89	11.95	34.50	92.70
			1992	322341	76819	9762	9040	23.83	30.28	12.71	11.77	28.04	92.60
			1993	312675	70465	10915	10033	22.54	34.91	15.49	14.24	32.09	91.92
			1994	350309	45791	8985	8326	13.07	25.65	19.62	18.18	23.77	92.67
4.	PHULBANI	12	1991	585648	183546	27018	24336	31.34	46.13	14.72	13.26	41.55	90.07
			1992	615576	167030	25181	23244	27.13	40.91	15.08	13.92	37.76	92.31
			1993	613141	141409	24006	22297	23.06	39.15	16.98	15.77	36.37	92.88
			1994	622082	136652	24568	23331	21.97	39.49	17.98	17.07	37.50	94.96
5.	SAMBALPUR	8	1991	587989	86592	4118	3634	14.73	7.00	4.76	4.20	6.18	88.25
			1992	590970	57065	4213	3738	9.66	7.13	7.38	6.55	6.33	88.73
			1993	593902	63822	5545	4962	10.75	9.34	8.69	7.77	8.35	89.49
			1994	620575	72783	5905	5249	11.73	9.52	8.11	7.21	8.46	88.89
6.	JHARSUGUDA	5	1991	423207	28081	1507	1404	6.64	3.56	5.37	5.00	3.32	93.17
			1992	434584	26520	1096	967	6.10	2.52	4.13	3.72	2.27	90.05
			1993	459467	25879	1259	1026	5.63	2.74	4.86	3.96	2.23	81.49
			1994	466433	19712	777	685	4.23	1.67	3.94	3.48	1.47	88.16
7.	DEOGARH	3	1991	223306	49886	7020	6635	22.34	31.44	14.07	13.30	29.71	94.52
			1992	224744	47991	5959	5683	21.35	26.51	12.42	11.84	25.29	95.37

			1993	1524162	358025	32314	30554	23.49	21.20	9.03	8.53	20.05	94.55
			1994	2163248	257367	33079	30768	11.90	15.29	12.85	11.95	14.22	93.01
16.	MALKANGIRI	7	1991	439776	69738	8804	8510	15.86	20.02	12.62	12.20	19.35	96.66
			1992	452283	67910	7820	6486	15.01	17.29	11.52	9.55	14.34	82.94
			1993	360483	53870	6781	6473	14.94	18.81	12.59	12.02	17.96	95.46
			1994	473442	52278	6350	6191	11.04	13.41	12.15	11.84	13.08	97.50
A1..N7													
17.	RAYAGADA	11	1991	684286	132753	18927	17181	19.40	27.66	14.26	12.94	25.11	90.78
			1992	697248	116623	17722	16179	16.73	25.42	15.20	13.87	23.20	91.29
			1993	698416	98317	13236	11994	14.08	18.95	13.46	12.20	17.17	90.62
			1994	719091	89406	12029	11108	12.43	16.73	13.45	12.42	15.45	92.34
18.	MAYURBHANJ	26	1991	1702192	333931	46593	40236	19.62	27.37	13.95	12.05	23.64	86.36
			1992	1780197	307063	34303	28144	17.25	19.27	11.17	9.17	15.81	82.05
			1993	2455188	285832	32594	28453	11.64	13.28	11.40	9.95	11.59	87.30
			1994	1889516	281509	32920	29383	14.90	17.42	11.69	10.44	15.55	89.26
19	KORAPUT	14	1991	928283	143237	16054	14765	15.43	17.29	11.21	10.31	15.91	91.97
			1992	951885	138359	18700	17460	14.54	19.65	13.52	12.62	18.34	93.37
			1993	951885	136552	15925	15183	14.35	16.73	11.66	11.12	15.95	95.34
			1994	1023573	118173	15047	14259	11.55	14.70	12.73	12.07	13.93	94.76
20.	NAWARANPUR	10	1991	788448	111039	9507	9050	14.08	12.06	8.56	8.15	11.48	95.19
			1992	825334	101577	10407	10112	12.31	12.61	10.25	9.96	12.25	97.17
			1993	825335	93378	9569	8070	11.31	11.59	10.25	8.64	9.78	84.33
			1994										
21.	ANGUL	1	1991	95946	22962	3577	3254	23.93	37.28	15.58	14.17	33.91	90.97
			1992	95946	17516	2008	1840	18.26	20.93	11.46	10.50	19.18	91.63
			1993	95946	15524	2434	2330	16.18	25.37	15.68	15.01	24.28	95.73
			1994	14808	16714	2469	2210	112.87	166.73	14.77	13.22	149.24	89.51
	G.TOTAL OF PHCs -	158	1991	11660337	2236048	303407	267317	19.18	26.02	13.57	11.95	22.93	88.11
			1992	11829220	2015519	269639	233658	17.04	22.79	13.38	11.59	19.75	86.66
			1993	12402852	1918444	234672	221399	15.47	18.92	12.23	11.54	17.85	94.34
			1994	13302968	1675653	226747	201831	12.60	17.04	13.53	12.04	15.17	89.01

EPIDEMIOLOGICAL PARAMETERS FOR P.F. PREDOMINANT PHCs

STATE - RAJASTHAN

2	3	4	5	9	10	11	12	13	14
NAME OF THE DISTT.	NO.OF P.F. PRODOMINANT PHCs	POPULATIO (IN 000)	YEAR	ABER	API	SPR	SFR	AFI	%PF
BANSWARA	8	1155	1991	10.5	2.7	2.5	1.3	1.4	51.7
		1155	1992	13.6	2.6	1.9	0.9	1.2	44.5
		1156	1993	13.3	3.4	2.5	1.4	1.9	55.2
		1156	1994	13.1	2.6	2	1	1.3	48.5
BHILWARA	1	125	1991	12.2	3.6	3	1.4	1.6	45.5
		148	1992	12	15.8	13.2	3.9	4.7	29.8
		148	1993	12.3	13.9	11.3	2.4	3	21.4
		148	1994	14.4	29	20	8	11.6	40
RAJSAMUND	2	235	1991	9.4	2.2	2.3	0.2	0.2	9.5
		141	1992	16	4.4	2.7	0.3	0.5	10.7
		141	1993	16.6	3.7	2.3	0.3	0.5	12.1
		155	1994	8.2	2.5	3	0.2	0.2	8.1
SIROHI	1	123	1991	8	14.1	17.7	2.4	1.9	14
		152	1992	7.7	10.4	13.5	5.3	4	39.1
		152	1993	9	11.8	13.1	3.1	3.1	26
		152	1994	8.7	14.1	14.5	2.8	2.8	19.6
UDAIPUR	8	1239	1991	10.5	4	3.8	1.5	1.5	38.3
		1315	1992	11.4	6.3	5.5	2.4	2.8	44.5
		1315	1993	11.6	8.3	7.2	2.4	2.8	33.1
		1317	1994	12.1	10	8.2	3.1	3.7	37.2
BUNDI	1	162	1991	13.4	4.8	3.6	2.3	3.1	64.2
		162	1992	14.2	13.7	9.7	4.6	6.5	47.7
		162	1993	9.1	6.3	6.9	2.1	2.2	34.8
		215	1994	9.4	4.6	5	2.2	2.1	45.3

JHALAWAR	1	131	1991	11	0.3	0.4	0.3	0.3	83
		148	1992	10.5	0.6	0.5	0.4	0.4	83.3
		148	1993	11.3	1.8	1.6	0.9	1	58
		148	1994	7.9	0.3	0.1	0.3	0.2	72.9
BARAN	3	267	1991	6.2	1	1.6	0.5	0.3	31.7
		319	1992	7.7	0.9	1.2	0.3	0.2	26
		319	1993	12.4	1.7	1.4	0.4	0.4	26.3
		307	1994	12.3	1.8	3.8	0.7	0.9	36.1
DUNGARPUR	5	874	1991	8	4.7	5.8	2.9	2.3	48.1
		874	1992	8.3	6.9	8.4	5.4	4.8	64.9
		875	1993	9.6	8.7	9	5	4.8	55.5
		881	1994	10.9	8.7	8	4.2	4.6	52.7
CHITTORGARH	4	394	1991	11.8	5.1	4.3	1	1.2	23.5
		470	1992	10	5	5	0.9	0.8	16.3
		470	1993	10.6	3.9	3.7	0.7	0.7	18.4
		470	1994	6.6	3.3	5.1	1	0.6	19.1
TOTAL FOR 34 PHCs		4949	1991	101	42.5	45	13.8	13.8	409.5
			1992	111.4	66.6	61.6	24.4	25.9	406.8
			1993	115.8	63.5	59	18.7	20.4	340.8
			1994	103.6	76.9	69.7	23.5	28	379.5

Malaria Situation of 19 Urban Towns in India

Sl. No.	STATE	Name of Town	Year	B.S.E	Total +ve	SPR
1	ANDHRA PRADESH	Visaka Patnam	1991	86958	7415	8.52
			1992	96442	12030	14.55
			1993	N.A	16034	-
2.		Hyderabad	1991	371447	3884	1.04
			1992	487937	3209	0.41
			1993	483364	2308	0.47
3.	BIHAR	Chaibasa	1991	465	63	13.54
			1992	371	61	16.44
			1993	238	69	28.99
4	GUJARAT	BARUCH	1991	17106	1820	10.63
			1992	25476	1297	5.09
			1993	30931	967	3.12
5.		DOHAD	1991	6680	934	13.98
			1992	5993	632	10.54
			1993	7865	1274	16.19
6.		GODHRA	1991	10927	2567	23.49
			1992	14136	2566	18.15
			1993	12508	2265	18.1
7.		VADODARA	1991	197310	18921	10
			1992	204828	15235	7.44
			1993	216464	16665	7.69
8.		AHMEDABAD	1991	156577	9932	6.34
			1992	135000	5916	4.38
			1993	115678	3887	3.36
9.	MADHYA PRADESH	BHOPAL	1991	68546	3872	5.64
			1992	68212	3737	5.48
			1993	99380	4196	4.22
10.	MAHA RASHTRA	NAVI MUMBAI	1991	598831	5335	0.89
			1992	501994	11879	2,37
			1993	508214	25171	4,95
11.	ORISSA	SAMBALPUR	1991	12531	2441	19.48
			1992	16661	2039	12,22
			1993	12898	157[illegible]	12.18
12.	RAJAS THAN	JODHPUR	1991	23189	2434	10,5
			1992	12712	426	3.35
			1993	21907	68[illegible]	3,1

13.		BHARATPUR	1991	7110	857	12.05
			1992	13228	1872	14.15
			1993	10632	1606	15.1
14.	TAMIL NADU	MADRAS	1991	587357	66937	11.39
			1992	299469	48447	16.18
			1993	308459	64234	20.82
15.		TUTICORIN	1991	21910	8359	38.15
			1992	8937	2202	24.63
			1993	40663	11370	27.96
16.		ERODE	1991	24614	3089	12.54
			1992	27399	3888	14.19
			1993	28435	3674	12.92
17.		DINDIGUL	1991	17155	4363	25.43
			1992	28756	7583	26.37
			1993	29396	9451	32.15
18.	KARNA-TAKA	BELLARY	1991	8223	570	6.93
			1992	8936	1005	11.24
			1993	N.A.	1770	-
19.	WEST BENGAL	CALCUTTA	1991	59391	13354	22.48
			1992	80064	17893	22.35
			1993	60235	16444	27.29

and demands sustained, long term interventions for which insecticides are less suitable as compared to bioenvironmental methods, although insecticides have important place in the integrated malaria control strategy under consideration. It is therefore proposed to change over from chemical based vector control to the integrated malaria control emphasizing non-chemical methods. This would be done in phases in the entire country. It is noteworthy to mention that malaria control in due course will improve health and socio-economic status of the communities. This will allow them to spare part of their earnings in providing protection to themselves. Improved economy will increase sustainability of the program, but may require the support of IEC activities.

3.3.4 A link worker would be recruited by the village Panchayat in Pf dominant areas to ensure EDPT. This link worker would be employed and controlled by the village Panchayat. He would be assigned the duties of malaria control related to the surveillance (EDPT), IEC and the maintenance & dispersal of larvivorous fishes within the boundaries of his village / hamlet including the fields under the control of Panchayat. Panchayats would be recommended to pay up to Rs. 500 per month honorarium from their own sources to the link worker. If Panchayats are unable to pay, initially this expenditure would be re-imbursed out of the WB assistance but efforts would be made to generate local resources and mobilize contributions from other agencies e.g., Rural development dept., Jawahar Yojgar Yojana, Tribal welfare dept. etc. The targets to mobilize resources/

contributions towards the link worker would be 20% (i.e. Rs. 1200) for each year so that at the end of 5 year period the entire link worker related activities would become self sustaining.

3.3.5 The policy of spraying all sections with 2 or more API based on 1977 API would be replaced by selective and targeted spraying under the over all integrated vector control strategy. In the revised malaria control strategy village has been taken as a unit and any village with indigenous 1 Pf case or 1 AfI or Pf. resistant foci or death due to malaria as per the expert committee guidelines, would be required to receive malaria control interventions on priority. Spraying would be more targeted to save resources and yet achieve malaria control. Therefore village wise analysis of information has become important. In order to achieve this objective special proforma, computerization and MIS system would be introduced for implementation under the WB assistance.

3.3.6 Malaria control in the defence, railways, multinational establishments, industrial houses, public sector undertakings, air ports and sea ports, restricted entry areas etc. to be taken out of NMEP and made the responsibility with full accountability of these organizations. All interventions should be carried out from their own sources with the technical help and training facilities of the NMEP. Malaria control programme would however be monitored by the Chief of the intersectoral committee at the district, state and central level, as the case may be.

3.3.7 Social and economic research would be linked with the epidemiological investigations and malaria control strategies so as to guide the programme on an economic and sustainable options in malaria control based on local situations. Simultaneously research would be directed on new methods of malaria control to improve the field operations. A mechanism is being developed by dovetailing MRCs field activities with the NMEPs field operations so as to incorporate research findings in to the programme without loss of time. This would be an agenda item in the Scientific Advisory Committee meeting of the MRC which is responsible for planning and research review of all the activities of the institute.

3.3.8 A programme of social marketing of insecticide impregnated bed nets, revolving fund, limited subsidies and marketing of bed nets on no profit basis is being worked out to reduce cost and also pass on some cost to the consumer.

3.3.9 In urban areas, vector control through deposit work would be carried out at the expense of the owner. This activity would become mandatory under the bye-laws applicable to all new constructions and properties which are likely to produce mosquitoes.

3.3.10 Malaria control in rural areas completely relies on chemical insecticides (e.g.,DDT, HCH, Malathion, and Deltamethrin), and in the urban areas chemical larvicides are used e.g., Temephos, Fenthion, Malariol. Biodgradable insecticides would be used for residual spraying under NMEP and

the application of CH compounds would be phased out. However there is no controversy in the use of chemical larvicides in the control of mosquito breeding as these are also biodgradable and the dosages applied are safe to warm blooded animals and the non-target species. Over all usage of insecticides is being substantially reduced under the revised malaria control strategy as it is proposed to change over to selective spraying and integrated control. Chemicals would be replaced both in rural and urban areas to the extent possible by the introduction of biological control methods, insecticide impregnated bed nets and curtains, environmental management methods, preventive vector control, invoke bye-laws etc. These methods would be applied uniformly all over the country and phasing out of insecticides will begin almost immediately. Insecticides would however be held in reserve for certain unforeseen situations requiring immediate short term control.

3.3.11 Environmental Impact of Chemicals: This activity has been assigned to the CSIR laboratory, National Environmental Engineering Research Institute, Nagpur. If any specialized study would be required, the same would be undertaken as sponsored research in consultation with the NEERI.

4. ACTION PLAN

Integrated malaria control under the NMEP has been developed along the same concept as enunciated under the global malaria control strategy, and follow up decisions taken by the directors of endemic countries who met in SEARO, New Delhi. Implementation

of this strategy would cover the entire country and would be adapted according to local malaria situation and tailored along the specific ecosystems. In the implementation of this strategy it is envisaged to change over from chemical approach to the application of integrated methods in all parts of the country. In order to implement this strategy some additional resources would be required particularly for intensified interventions in P. falciparum dominant areas. This has been done for the north eastern states by making malaria control a 100% centrally sponsored scheme. Intensified malaria control in the peninsular India would require WB financing in addition to the general malaria control approaches and resources already available.

4.1 DISEASE CONTROL

As stated before prevention of malaria and prompt treatment of malaria is a fundamental right of all populations at risk of the disease. Therefore in the integrated malaria control strategy "disease control" takes priority. To achieve this objective primary health care system is being tuned for improved field operations.

4.1.1 Early Case Detection and Prompt Treatment (EDPT): Several studies have pointed out defects and inadequacy in the present system of drug distribution through the MPW,DDC & FTD. The system of centralized microscopy at the block PHC level (30,000 population level PHC do not have a microscope) is deficient as the results are not available in time and often

- DIAGNOSIS FACILITY
- STOCK of DRUGS WITH VOLUNTEERS
- REFERRAL SERVICE
- UPGRADING of FACILITIES
- TRAINING

★ TRAINING of LINK WORKER (VHL)
★ TRAINING of LAB TECH in Quick Dx by MP

delayed for weeks. These problems are pronounced in the remote and inaccessible areas, some of which remain cut off for long periods following monsoon and floods. EDPT supported by a well organized drug distribution system and strengthening of referral system with upgradation of treatment facilities and training is expected to correct this situation. EDPT will comprise of the following components.

✓ (i) A link worker would be appointed by the village Panchayat to collect blood smear (1) from suspected cases of malaria, (2) provide presumptive treatment and (3) forward the slide to the PHC. As per this policy each village Panchayat in high P. falciparum area would have one link worker.

✓ (ii) All PHCs (30,000 population) will be given a microscope for rapid diagnosis. In peri-urban areas microscopes would be given @ 1 per 50,000 population.

Microscopy at the PHC level: Block PHCs are being converted to 30,000 population PHCs. There was invariably back log of slide examination for up to 6 to 8 weeks. This was a serious constraint in the early diagnosis and prompt radical treatment particularly in areas where alternative diagnostics and treatment facilities were not available. Many malaria cases were treated by the quacks. Microscopic diagnosis would now be available to 30,000 population and this will help reduce malaria associated morbidity and mortality.

Rapid diagnostics: In many situations early malaria diagnosis is important to save life. Specifically these

☆ Traing of Doctors at Plc Level / DPHN's
on management of Malaria
+ Preparing a guideline, MO-CH

situations are the non-availability of a technician during leave, holidays and in the after office hours. The following steps would be initiated to improve the situation.

(i) Dipstick test would be allowed in the private sector to speed up correct diagnosis. ✓

(ii) Each PHC, district hospital, and medical college hospitals would be given dipstick diagnostics for 10 cases per month to be used during emergencies particularly when the laboratory diagnosis is not available and it is considered critical in the management of a case e.g., pregnancy, doubts in the microscopy, life threatening disease etc.

4.1.2 Referral and treatment facilities: At present there is no organized referral system. Serious cases of malaria are not attended by the PHC doctor and there are no guidelines at the PHC level. PHCs lack drugs, treatment facilities and there is no provision of transportation to district level hospital during emergencies. To improve this situation the following actions would be initiated.

✓ (i) Training of doctors of the PHCs, district hospitals and medical colleges.

✓ (ii) Guidelines for the treatment of serious and complicated malaria cases (from WHO country budget).

(iii) Serious cases of malaria would be managed at the PHC level.

(iv) There would a provision of referral to higher level for

patients requiring consultancy and advanced treatment.

(v) All district level hospitals and medical colleges would be supplied a microscope.

(vi) Priority in admission to serious and complicated malaria cases.

(vii) Adequate supply and timely replenishment of anti-malarial drugs.

4.1.3 Drug policy: The anti-malaria drug policy was adopted in 1982. Malaria epidemiology and new developments in technology and treatment related to malaria have made it imperative to review the national malaria treatment policy. Consequently in 1995, the government of India set up an expert group to review in-depth the anti-malaria drug policy in the context of changed circumstances. The expert committee has taken note of the following developments in drafting the new anti-malaria drug policy (Annex 2).

(i) P. falciparum in the country had not responded to the special efforts made in its containment and spread e.g., the P. falciparum containment programme (Ray et.al. 1988) and the modified plan of operation (Pattanayak and Roy, 1980). P. falciparum is a killer parasite and resistance has made the treatment difficult, complicated and costly.

(ii) Resistance in P. falciparum had intensified and spread rapidly from its initial focus detected in Assam in the Karbi-

Anglong district in 1973 (Sehgal et.al. 1973). Complaints of resistance/drug failure have been reported both from within and outside the NMEP.

(iii) Dosage for presumptive treatment (PT) were considered inadequate due to loss in parasite sensitivity. Also the back log in slide examination required that a gametocitocidal drug (PQ) should be administered along with 4 AQ to control P. falciparum transmission.

(iv) Some drugs were considered toxic (e.g., Amodiaquine) and had no advantage over chloroquine and yet costly (Mishra et. al.1995).

(v) Some drugs were not allowed in the private sector (e.g.,Primaquine). Changed circumstances demanded the availability of this drug in the open market.

(vi) New drugs and drug combinations had become available for the treatment of resistant malaria and serious and complicated malaria (e.g., Mefloquine, Fansimaf, Halofantrine, Artesunate, Artether etc.) and there was an urgent need of taking note of these developments.

(vii) Some drugs required to be administered in higher dosage e.g., chloroquine, sulphalene or sulphadoxine pyrimethamine combinations for achieving radical cure in all cases as there were reports of the loss of drug sensitivity in P. falciparum.

(viii) To identify areas of research requiring immediate

attention of the scientific organizations.

4.1.4 Drug distribution net work: A major cause of malaria outbreaks and epidemic situations reported from various parts of the country is the breakdown in the surveillance and the drug distribution network. Malaria cases unable to find drugs approach quacks and suffer extended morbidity. Deaths due to malaria are mainly confined to areas with shortage of drugs. Malaria mortality and morbidity can be largely reduced by the timely availability of drugs. Following actions would be initiated to improve the drug distribution system.

(i) One fever treatment depot (FTD) per village. FTD would be a voluntary activity assigned to Panchayat head who may share this work with one or more Panchayat members. Panchayat will also function as drug depot and supervise the link worker and replenish supplies,

(ii) Link worker to be appointed by Panchayat normally one for 2,000 population.

(iii) Existing MPW and ANM will continue to function as before and help Panchayat in the collection of blood smears and drug distribution.

(iv) Adequate quantities of anti-malarial drugs would be made available throughout the primary health care system.

4.1.5 Private Sector: Involvement of the private sector can be very helpful in the correct and early treatment of malaria. To

reduce mortality and morbidity due to malaria in patients who normally seek treatment from private doctors, the following actions are being initiated to elicit their cooperation in correct diagnosis and treatment.

(i) Dipstick test would be available in the open market.

(ii) Training in diagnosis and treatment to doctors through IMA.

4.1.6 Monitoring: Drug supply would be monitored to ensure adequate drugs throughout the primary health care system, and the voluntary institutions appointed for this purpose; and so also malaria incidence and deaths. Sufficient stocks would be maintained at the Hqs. in Delhi and the state capitals for this purpose. A provision is also being made to procure drugs locally at the district level in case of short supply. Side effects, if any of the anti-malarials would be monitored as a routine activity through the PHC system. Drugs for the treatment of side effects and treatment guidelines would be available at the PHC level. Monitoring of incidence of malaria would be through the well established system of ACD, PCD, APCD, and data generated by the private sector. It would become mandatory to identify a case of malaria and establish the species of malarial parasite wherever the microscope and dipstick test is available including the private sector. Data from the PHCs and private sector would be recorded, compiled and collated to provide information of the proportion of severe malaria and complicated cases to total P. falciparum cases, and also on the malaria specific mortality rate among high risk groups. Criteria of malaria death would now be on

the basis of clinical diagnosis of malaria rather than the demonstration of malaria parasite in the blood film.

4.2 VECTOR CONTROL

There are 57 Anopheles mosquito species in India. Of these 6 anophelines are major vectors of malaria. Table 4 gives in brief the distribution and biology of these vector mosquitoes. Insecticide based vector control has become unsustainable and therefore non-chemical methods would be the first line of attack in vector control. To achieve this objective, reliance in vector control is being shifted from total dependence on insecticides to integrated vector control adapted to local situations. This would involve the application of biological and environmental management methods along with the insecticides. It is proposed to phase out insecticides in due course and limit their application in special situations e.g., epidemic control, disturbed areas, in places where alternatives to insecticides are either not available or unlikely to succeed.

4.2.1 Bioenvironmental methods: In India bioenvironmental methods have been used extensively in the control of urban malaria. In the last decade or so scientists at the MRC have demonstrated malaria control in a variety of epidemiological situations. Results so far have shown that wherever these methods are applicable malaria control is cost effective, sustainable, utilizes indigenous technologies and talents, does not interfere with the ecology of the area, produces malaria control without

Table 4- MAJOR VECTORS OF MALARIA IN INDIA

A) BIOECOLOGY CHRACTERISTICS

NAME OF THE VECTOR SPECIES		ZONE OF INFLUENCE	BREEDING ECOLOGY	ADULT BEHAVIOUR
(1)		(2)	(3)	(4)
1) A. culicifacies				
Sibling (Vector)	A	Vector of rural malaria in the North, South & Central India	Breeds in river margins, riverbed pools, irrigation systems, seepages, rainwater collections, borrowpits, and shoreline pockets in dams and lakes. Also breeds in hoof marks, wheel ruts, ricefields, wells, ponds, pools of water supply systems and lowlying grounds etc.	Rest in cattlesheds and houses, straw, mudcakes near stables, and dense vegetation. It bites throughout night but peak hours being between 19.00 and 4.00 hrs alongwith variation from place to place
Sibling (Non vector)	B	All over India except North East		
Sibling (Vector)	C	East to West in the central part of the country		
Sibling (Vector)	D	Patchy in species A areas		
2. A. stephensi		All towns except North East; rural areas of arid/ semi arid zone except in the north	Predominantly breeds in wells overhead or ground-level water tanks, cisterns, coolers, roof gutters and artificial containers. Scanty breeding in ricefields and polluted brackish water habitats.	Adults rest in wells, houses, cattlesheds and barracks etc. Peak biting time 22.00 to 24.00 hrs,

NAME OF THE VECTOR SPECIES	ZONE OF INFLUENCE	BREEDING ECOLOGY	ADULT BEHAVIOUR
(1)	(2)	(3)	(4)
3. A. minimus	NE states, North West Bengal	Breeds generally in streams, ditches, channels in tea gardens drains etc, which have a perceptible but slow flow of water. Occasionally it also breeds in borrowpits, ricefields and seepages. It prefers shady areas	Rests in houses and cattle-sheds during day and mostly outdoors. Peak biting time 18.00 and 19.00 hrs. outdoors and 24.00 and 2.00 hrs indoors
4. A. fluviatilis	Foot hills all along the Himalayan range, seepages in irrigation channels	Breeds in perceptible flow of water such as field channels, slow moving seepage channels of dams and irrigation channels. Also recorded in shallow wells, tanks, ricefields (growing and fallow) along the foothills or undulating terrains, swamps borrowpits during monsoon period when streams and channels are flushed by heavy rains.	Adults generally rest in human dwellings and to lesser extent in cattlesheds during day. It also rests outdoors. Peak biting activity occurs between 20.00 and 24.00 hrs

NAME OF THE SPECIES	ZONE OF INFLUENCE	BREEDING ECOLOGY	ADULT BEHAVIOUR
(1)	(2)	(3)	(4)
5) A. dirus	Deep forests in NE region	It is a pool breeder in dense jungles. Also breeds in pools by the side of rocky streams, disused wells, rain-water collections, borrowpits, drains in densely-shaded foliage and stagnant waters in jungles	Rests infrequently inside houses and cattlesheds during daytime. Exophagic bites from 19.00 to 4.00 hrs but the peak biting activity is between 22.00 and 2.00 hrs.
6) A. sundaicus	Andaman & Nicobar islands	Breeds mainly in brackish water but also breeds in fresh water. Major breeding places are swamps and pits along bunds etc. containing stagnant, brackish water. Also breeds in salt water lagoons, creeks, wells (brackish water or fresh water), overhead tanks and freshwater pools in coastal areas. Can tolerate salinity from 0.08 to 2.6 per cent and pH ran 7.7 to 8.5	Rests specially indoors of human dwellings, cattlesheds and also outdoors, in rock crevices in sand banks, and bushes in forest areas

MAJOR VECTORS OF MALARIA IN INDIA

B) CONSTRAINTS AND APPROACHES FOR CONTROL

NAME	RESISTANCE STATUS	TECHNICAL OBSTACLES IN CONTROL	APPROACH TO CONTROL	
			LARVAL	ADULT
	(5)	(6)	(7)	(8)
1) A. culicifacies	Resistant to DDT, HCH and to Malathion in South Gujarat, Maharashtra, Madhya Pradesh	i) Insecticide Resistance ii) Poor spray coverage iii) Mud plastering in tribal area iv) Refusal in tobacco growing and silk culture areas	a) Rural Not required b) Peri Urban i) Larviciding ii) EMM legislative measure iii) Fish	a) Residual spraying i) Malathion b) ITBM i) Repellents
2. A. stephensi	Resistant to DDT, HCH in many places and malathion	Frequent GR	i) Source reduction ii) Larviciding iii) Legislative methods iv) Fish v) Neem balls vi) Minor Engineering works	Fogging to control epidemics
3. A. minimus	Susceptible to insecticides	i) Exophilic (Ph) ii) Exophagic (Ph)	i) EMM	i) IRHT

NAME	RESISTANCE STATUS	CONTROL CONSTRAINT	APPROACH FOR CONTROL	
			LARVAL	ADULT
	(5)	(6)	(7)	(8)
4) A fluviatilis	Susceptible to insecticides	Exophily and exophagy	i) EMM	HBN at low altitude residual spray at IBNT
5. A. dirus	Susceptible to DDT	Exophily and exophagy	Forest breeder. Difficult to control	IBNT
6. A. sundaicus	Susceptible to DDT	Adapted to form local populations. Comprising both of exophilic and exophagic and endophilic and endophagic populations	i) EMM (sluice gates) Embankments ii) Fish iii) Salinity changes	a) Spray for Endophagic/ Endophilic DDT b) IBNT for Exophilic & Exophagic

any problems as are common with the use of chemicals, generates employment, inculcates scientific temper, and can be dovetailed with the developmental activities and income generating schemes of the area (Sharma, 1987). The following actions are envisaged to promote bioenvironmental methods in the country. Fishes (Guppy, Gambusia, Killi-fishes, and a few indigenous fishes discovered by the MRC) are low cost and sustainable solution to the control of mosquito breeding (Sharma and Ghosh, 1994). In all PHCs of Gujarat larvivorous fish hatcheries are being maintained at the PHC level. Similarly larvivorous fish hatcheries would be established throughout the country at the PHC level and CMOs/DMOs/ADMOs would be required to ensure maintenance of fish hatcheries. Adequate budgetary provision is being made for this purpose. Fishes would be distributed in all mosquito breeding areas by the MPW/Link Worker/Volunteers and sanitation workers (others to be identified) in the rural and urban areas. Fish programme would be linked with the inland fisheries department and research on larvivorous fishes would be encouraged through the well established net work of research institutions working under the ICMR/ICAR/Agriculture Ministry.

Bacillus thuringiensis H-14 (Bt) and Bacillus sphaericus have been extensively tested at various locations in the country in the control of mosquito breeding of the disease vectors. The two products Bacticide and Sphericide produced control of mosquito breeding from 2 to 4 weeks and in some cases even longer. Field trials have demonstrated the usefulness of these biolarvicides in the control of mosquito breeding (MRC, 1993).

Toxicological investigations carried out by the scientists of Indian Toxicological Research Centre (ITRC), Lucknow, U.P. have established the safety of these products to humans and non-target species. Based on these findings Bt & Bs were registered by the insecticide board. Of the 2 products Bacticide is specific for the control of Anopheline mosquitoes. Selective application of Bacticide is contemplated in 19 towns identified for the accelerated malaria control. In these towns Bacticide instead of Malariol would be used in the control of mosquito breeding. Bacticide is safe and competes in cost and has the advantage that the product has no other value and can not be mis-used.

Environmental management methods would be applied following the health impact assessment recommendations to prevent vector breeding and also through the inter-sectoral coordination in various development programmes of the government and the private sector. To promote these methods training programmes have been prepared.

4.2.2 Selective spraying: Insecticides continues to be the main stay of malaria control in the country. In the integrated malaria control strategy surface area for the application of insecticides in malaria vector control has been reduced by taking village as a unit. Villages showing either one P. falciparum case or 1 AfI would be sprayed. It would be difficult to implement this strategy without strengthening management information system and decentralization of decision making. This would be installed in time, and precede the choice of insecticide and its spraying based on new criteria. Selection of insecticide would take in to

consideration cost, acceptability by the communities, vector susceptibility and transmission dynamics of malaria. Spraying would therefore be impact oriented, more targeted, and save resources. It is envisaged to phase out insecticides and limit their role in special situations. Insecticide cost would be met from internal resources and no proposal is being made for external assistance.

2.3

4.2.3 Insecticide impregnated bed nets: In India use of bed nets and curtains treated with synthetic pyrethroids has produced high impact in curtailing malaria transmission unattainable by the residual spraying with DDT, HCH and malathion (Sharma 1995; Jana-Kara, 1995). In certain tribal dominated areas success of bed net programme may be impeded by the sociological factors requiring targeted IEC. Bed net programme is cost effective compared to residual spraying, involves communities, and produces collateral benefits. SP compounds do not re-cycle in nature and there is no resistance to SP compounds in the Indian anopheline vectors. Global experience in the use of bed nets is also indicative of the usefulness of treated bed nets in malaria control. Change over to bed net programme may require re-organization of the health services and re-assignment of duties at the district and PHC level, and this would be suitably done on need based recommendations. Bed net programme would have the following special features.

(i) Bed net procurement would be decentralized at the district level in consultation with the state health department.

Bed net impregnation would be done by the communities at the PHC. Insecticide would also be marketed in sachets for those unwilling or unable to come to PHC for impregnation. It is estimated that not more than 25% population will come to the PHC and most people would buy sachets for impregnation. This would encourage community participation, cost of insecticides would be shared by the communities thus lessening the burden on the government. This will also help in increasing the sustainability.

(ii) A revolving fund would be established by the NMEP at district level for the subsidized sale of bed nets. Funds would also be used to provide free bed nets to high risk groups of low socio-economic status. In areas outside the WB financing in the first year there would be 50% subsidy and in the second year 25% subsidy. Thereafter communities would be required to buy their own bed nets which would be available through special arrangements of social marketing. For the bed net revolving funds a suitable mechanism would be evolved in consultation with the state health departments.

4.2.4 Personal protection: There are many methods to reduce man mosquito contact and thus eliminate the possibility of contracting malaria and prevent mosquito nuisance. Mosquito nets are the most popular method and used compusorily in the defence forces. There are many devices marketed in the country such as the mats, Kachhua Chhap, oils, creams etc. Studies at the MRC have shown that these devices provide only partial protection from mosquito nuisance and there is no documented evidence of

protection from acquiring malaria. Recent research at the MRC has brought out the useful role of neem oil as mosquito and sand fly repellent (Sharma et.al. 1993). Studies have also shown that neem oil is low cost, indigenous, safe to humans, acceptable to the communities, methods of application are simple and can be integrated with the primary health care system. IEC activities would be directed to promote the use of neem oil and use other methods of personal protection. It is proposed to distribute one time small dispensable bottles of neem oil through the PHC and ration card system along with literature on the methods of application.

4.2.5 Legislative measures: (i) Municipal Bye-laws: At present help of legislative measures in the control of mosquito breeding is limited to some towns. Bombay Municipal Corporation has good experience in execution of bye-laws for the prevention of mosquito nuisance. Annex 2 gives the existing bye-laws of the BMC and these could be either extended to other areas or adapted by the states/ central government to provide a common legislation. Bye laws would be promulgated and enforced to prevent the creation of mosquito breeding sites. Bye-laws would cover the industrial, urban, and development areas.(ii) Building Bye-laws: Modifications in the existing building bye-laws of Delhi Development Authority and Municipal Corporation of Delhi under adoption should be extended throughout the country. This would further supplement the efforts in reducing the mosquitogenic potential associated with the structural designs of the buildings.

COMMUNITY HEALTH CELL LIBRARY AND DOCUMENTATION UNIT

4.3 MALARIA CONTROL SUPPORT ACTIVITIES

4.3.1 Health impact assessment: Even before the discovery of malaria transmission by Sir Ronald Ross in 1898, people by experience had come to know that marshes were the main cause of malaria. This was experienced in India as the command areas became death traps after the Ganga canal construction in 1856. Subsequent to this experience, drainage was considered an important requirement of any irrigation scheme. For example to fight the famines in Oudh province in north India the construction of Sharda barrage at Banbasa and its head works were delayed and no work was undertaken for about four years mainly because the drainage cuts were not determined. Other successful examples are the construction of Imperial city of New Delhi in 1913, the opening of Cauvery irrigation canal from K.R. Sagar dam in 1930. In those days and until the release of DDT in malaria control in the 1950s, health impact assessment and necessary modifications were mandatory at the planning stage and proper maintenance ensured in all developmental activities and human settlements etc. This important lesson was forgotten with the powerful impact of residual spraying of insecticides as a standard method in malaria control. At one time famous courses organized by the Malaria Institute of India on the engineering methods of malaria control were also terminated. The governments became complacent and ignored the adverse impact of creating malariogenic potential throughout the length and breadth of the country. As the insecticides started to loose their impact in the

control of mosquitoes due to resistance, malaria started to enter new areas and occupied new niches. This process over a period of 3 to 4 decades established new ecotypes related to developmental activities. Time has now come to take a serious note of this ecological hazard associated with almost complete dependence on insecticides. Renewed attack on malaria would require a change over to more rational approach and this need has become obvious. HIA therefore becomes very important in terms of preventive vector control and in organizing interventions based on ecological considerations. Unfortunately at the present time when this expertise and experience is needed most people with experience are few, not easily available and unlikely to match the national needs. Therefore the need of the program is to arrange the transfer of technology from the well established institutions in the world and develop a large man power base in the country to take up HIA. The following actions are suggested as part of the WB assistance.

(i) Fellowship programme of 3-6 month duration to biologists and engineers (public health, civil and allied fields) for training abroad on HIA in EIA. Faculty members from the engineering colleges, universities and training institutions would be given 6 months training. Institutions making a provision for organizing diploma courses or those willing to include this activity in their regular teaching curriculum would be selected for this advanced training. These institutions will serve as training grounds for the country. All others will be trained for 3 months duration. It is envisaged to train 100 specialists from

the engineering colleges, universities; 100 specialists from non-health sectors, and 100 professionals from the malaria control organizations.

(ii) Course curriculum development for engineering courses and short term courses for non-health sectors. A manual on the engineering specifications for anti-malaria civil works for all projects would be prepared for circulation in the country. A consultative group of experts from the PEEM of the WHO would be assigned this task so as to draw on the best talents available.

4.3.2 Intersectoral coordination: Intersectoral committees would be constituted at the central, state and district level. Bye-laws would require that each autonomous institution and industrial house also have intra-sectoral committee with a pointed reference to the control of mosquito breeding in their premises. At present mega projects require the clearance of the GOI Department of Environment. It would become mandatory for all projects to be planned and amended as per the guidelines provided by the NMEP and these designs would be examined and certified by a committee of experts designated by the NMEP. A representative of NMEP would follow the incorporation of remedial measures at the design and execution stage and ensure proper maintenance. At the state and district level these committees would ensure similar action for all projects. Intersectoral committees would also be responsible for the prevention of mosquitogenic conditions in their own deparmental works and provide adequate budgetary provision. The existing environmental problems that require amendments and corrective action from malaria view point

would be identified for the control of mosquito breeding by the biological and environmental management methods and resources allocated to the executing agency by the government.

4.3.3 Training: Change over from the insecticide spraying to the integrated malaria control would require large man power to be trained at all levels. The new strategy envisages decentralization of malaria control activities and decision making at the district level, increased emphasis on community based activities, intersectoral coordination, and in the urban and industrial areas implementation of the legislative measures. Furthermore integrated malaria control would also incorporate IEC, MIS, NGOs and private sector. This would be a large man power development programme belonging to health and non-health sectors. Therefore training would be decentralized and various training modules would be developed which would also include use of video in teaching etc. Activities to be undertaken related to continuing man power development with budget estimates are given in Annex 3.

4.3.4 Research: A major health programme spread over the entire country can not run effectively without research support. In the past Malaria Institute of India was the centre of all activities related to malaria control operations in the field. During the period of resurgence malaria control lacked research support. In the last 2 decades, malaria research has been revived in the country and many research programmes have been activated Malaria research would be strengthened to lower malaria

transmission below economic threshold and maintain at that level so that the existing primary health care can manage it without any visible burden.

(i) Institutional strengthening: Malaria Research Centre (ICMR) is the only Institute in the country exclusively devoted to malaria research. The Centre works in close collaboration with the NMEP and many other national and international organizations. At present 12 field stations located in endemic areas provide net working facilities for undertaking field research on malaria relevant to the NMEP. MRC has already developed good expertise in research with a well developed infrastructure, and has already made important contributions in research, training and IEC. MRC needs strengthening by way of buildings, equipments and training. A proposal as given in Annex 4 has been forwarded to the WB through the ICMR.

(ii) Applied and Operational Field Research: Scientists of the NMEP and MRC have jointly identified areas of applied and operational research that are important to the success of the malaria control action plan. Studies requiring priority attention are the following:

A. Applied Research

PROJECT 1: Insecticide resistance: Studies on resistance in An.culicifacies to synthetic pyrethroids would be important in view of the change over from CH and OP compounds to SP compounds. An. culicifacies has already become resistant to DDT, HCH and

Malathion, but field populations are fully susceptible to synthetic pyrethroids (SP). In the integrated malaria control strategy, SP compounds would be used in large quantities for some time as residual spray, and largely for the impregnation of bed nets. Exposure of vector populations to SP compounds may create problems in control either by inducing resistance or exophilic behavior. Applied field research is therefore indicated on the: a) proportion of deterrent and killing action of SP compounds used in dipping of bed nets; b) mechanism of resistance to SP compounds and cross resistance within SP compounds in species A and species C of An. culicifacies; c) exophilic vector behavior and impact of bed nets in accelerating selection for exophilic vector behavior; and d) counter measures to overcome resistance and exophilic vector behavior to SP compounds. Since bed nets would be used in areas under the influence of An. stephensi, An. minimus, An. fluviatilis and An. dirus, similar studies may be required against these vectors as well.

PROJECT 2: There are reports of resistance in P. vivax to chloroquine from Indonesia, Papua New Guinea, an a few more. It is possible that P. vivax strains resistant to chloroquine may also be evolving in India. It is therefore important to detect early and take remedial measures to eradicate the build up of such foci. Monitoring of P.vivax sensitivity to chloroquine is therefore indicated all over the country.

PROJECT 3: Large quantities of anti-malarial drugs are used in the treatment of malaria, but reports on the side

effects/serious reactions are few and not well documented. Obviously such drug reactions are being missed. An epidemiological investigation is indicated on the drug reaction particularly in high risk groups and those with genetic abnormalities.

PROJECT 4: Malaria is entering into new areas due to environmental changes. A study on the impact of ecological changes, global warming and meteorological factors is important in the context of rapidly deteriorating epidemiological situation of malaria.

PROJECT 5: 1994 epidemic in Rajasthan has thrown up many challenges in regard to vector control and management of disease. Arid zone ecology of malaria transmission is poorly understood particularly under the abnormal conditions of rainfall and irrigation. An. stephensi was a well known vector in Rajasthan but now there are vast stretches of land water logged due to Indira Gandhi Nahar where An. culicifacies has a strong foot hold. Additionally An. fluviatilis has been reported in some areas. Precise role of these vectors in malaria transmission has to be investigated. It is important to investigate the vector biology of the immatures and adults to develop new control tools. Studies are also required on the status of resistance in P. falciparum, dynamics of transmission, methods to prevent deaths in difficult to reach areas and develop a package suitable for the Panchayat to prevent vector breeding and take remedial measures as may be required to interfere with the local

transmission.

PROJECT 6: Long term research support is indicated on the diagnostics, new drugs, new insecticides, immunological studies, new approaches in malaria control e.g., remote sensing, geographical information system, micro-epidemiology using molecular approaches etc.

B. Operational Research

PROJECT 1: The problem of chloroquine resistance in P. falciparum is increasing. Urgent need is felt in the programme to investigate the transmission dynamics of drug resistant P. falciparum malaria; diffusion mechanism and speed with which resistant strains are moving inwards from the international borders and methods of control. Because of the implications of drug resistance in the treatment of malaria, it is felt that a suitable mechanism may be developed for rapid assessment of the status of drug resistance in P. falciparum. For this purpose feasibility studies may be undertaken on 3 and 7 day in vivo test at the primary health centres.

PROJECT 2: Early warning system applicable and sensitive for the existing primary health care system should be developed. This would require collection of sensitive parameters, computerization of data, and soft ware to raise alarm before the onset of epidemics. This will abort outbreaks, prevent diffusion of disease, reduce morbidity and mortality and save resources required in fighting the epidemic situations.

PROJECT 3: Agriculture, industry, construction works, etc. attract labour and largely the pattern of population migration is well established. Droughts, floods, disturbed political situation also cause large scale population movements. There are no epidemiological investigations of the impact of migration in the dissemination of parasite strains, particularly the incidence of serious malaria episodes, mortality due to malaria in the indigenous population and impact on the build up of resistance in P. falciparum to anti-malarial drugs. Results of this study would help in the development of strategy to prevent the dissemination of the parasites.

PROJECT 4: There are a very few studies in the country on sociological factors affecting the success of malaria control programme. These studies have become all the more important in view of the change over to the integrated malaria control strategy envisaging the active participation of communities and involvement of Panchayats in the prevention of malaria morbidity and mortality and in the sanitation programme. In this context it is important to know the felt needs of the communities, how the communities perceive malaria, vector breeding sites and how these are being created, behavioral studies related to the use of drugs and their faith in various systems of medicine etc. In regard to interventions, particularly success in insecticide impregnated bed nets will depend on the proper use and care of bed nets and therefore studies are indicated on the human factors that will interfere with the proper bed net usage as a method of malaria control, in each ethnic group.

PROJECT 5: Cost effectiveness of malaria control requires continuous monitoring of the impact of interventions and a cost analysis directed to bring out the best combination of methods applicable under a given epidemiological situation. Therefore, practical methods of cost analysis under a decentralized malaria control programme would have to be developed and field tested before these are incorporated in to the training modules on the implementation of integrated malaria control strategy.

PROJECT 6: The components of information, education and communication (IEC) are weak in the programme. IEC component in the delivery of an effective malaria control programme based on community approach would require the knowledge of local transmission, problems in malaria control, vector biology of the target species, factors of human ecology, sociological factors, and control tools. This would help in designing targeted IEC material in local language(s) keeping in view the perceptions, expectations and responsibilities of the communities in malaria control. This would be in addition to the general IEC at the national and state level. Research is indicated on the development of suitable IEC material at the lower levels of health delivery system.

PROJECT 7: Health impact assessment (HIA) in the environment impact assessment (EIA) is being introduced as an important component of the malaria control strategy. In many areas of growing economy projects in the field of agriculture, industry, human settlements etc. have created enormous mosquito

breeding potential. Research is indicated on the magnitude of this problem, mitigating measures which are cost effective and sustainable and future planning to prevent malariogenic conditions.

PROJECT 8: Management information system is being developed and strengthened. Research is indicated on the integration of malaria activities, soft ware development, data collection and analysis, information dissemination for rapid action, and programme planning for the smooth functioning of the malaria control activities at the periphery.

4.3.5 Community participation: Devolution of powers to the lowest level, i.e. the village has already occurred in many states and other states are in transition stage. The terminology used is "Panchayat Raj", and all programmes would be executed through the elected representatives of the people. Therefore the approach to planning would be "bottoms up" in which village Panchayat would be responsible for all matters related to health and development. In the integrated malaria control village Panchayat would be nodal point for the delivery of malaria control activities. Panchayat would function as FTD, hire and supervise the work of Link Worker, provide sites for fish multiplication, participate in sanitation programme, help in bed net distribution and impregnation, keep watch on the environmental degradation, spread the messages and any other activity related to malaria control where people's involvement is

crucial to reduce cost and increase sustainability of the interventions (Sharma, 1993a). DDCs and FTDs would continue to function as before and this is a well established voluntary activity. Private sector would be activated and given full training either by organizing special courses or through the IMA. Furthermore community participation would also be elicited in source reduction by the legislative measures and development of IEC material in local dialects and regional languages.

4.3.6 Voluntary agencies: Non-government organization can be of great help in malaria control. These organizations are motivated and have developed a close liaison with the local people. Activities of the NGOs are widely appreciated and demanded as they primarily address to the felt needs, perceptions and aspirations of the people in their surroundings. NGOs would therefore be fully involved in all interventions and reporting of unusual events. NMEP has already identified some voluntary agencies and more are yet to be identified. Some NGOs may need motivation to include malaria control as one of their important function and wherever possible intervention material would be distributed through the NGOs to establish credibility.

4.3.7 Private sector: In the endemic areas people unable to avail the facilities provided by the health services due to a variety of reasons, end up with the private practioners who may or may not be trained in the diagnosis and treatment of malaria. To extend the benefit of malaria control to this community private sector would be motivated in malaria control as per the

guidelines provided by the NMEP. This would mean training, information dissemination, and data collection at periodical intervals. A system would be developed at the village level and also in the urban areas to achieve this objective. Private practioners would be encouraged to use dipstick method of malaria diagnosis, and provided treatment guidelines and proforma for reporting.

4.3.8 Management information system (MIS): Decentralization of malaria control programme would be suitably linked with the management information at the district level. Data collected through various health functionaries and other sources like the NGOs, private sector etc. would be entered in the computer, analyzed and communicated to various agencies for the planning and control of malaria. E-mail and fax facilities are being provided at various locations to speed up communication for early decision. (Annexxure).

4.3.9 Information, education and communication: The coverage of malaria control activities through the IEC would be country wide. Special emphasis would be given on the preventive methods of malaria control, how communities can participate in various intervention works, what to do in case of fever, and the proper use and dosage of anti-malaria drugs. Educational, publicity material, various video programmes, posters, charts, popular lectures etc. would be prepared in the regional languages to sensitize the communities. Special IEC programmes would be designed to educate and inform the private sector.

4.3.10 Decentralization of malaria control: Zila Parishad would be the nodal point for the implementation of malaria control programme. In the district DMO/Dy CMHO would be responsible for all interventions, bed net programme, maintenance of revolving fund of the bed nets, and data analysis. A computer with requisite soft ware and printer would be made available to the DMO/Dy CMHO. At the PHC level MO PHC would be responsible for EDPT and analysis of malaria situation of the PHC. At the village level, village Panchayat chief would be responsible for surveillance, drugs, maintenance of fish stocks and their distribution to control mosquito breeding.

4.4 EPIDEMIC CONTROL: Epidemics occur in unstable malaria areas and may bring death and panic. Furthermore there is an imminent fear of spreading the problem of drug resistance. Therefore timely detection and liquidation of resurging foci would be given immediate attention for control and abort the epidemic. It has been repeatedly observed that outbreaks/epidemics occur because of the break down in surveillance and shortages of drugs for extended periods resulting in accelerated transmission during the years of good rainfall. The following strategic decisions are being taken to prevent and control epidemics.

4.4.1 Vacancies: State governments would be persuaded to fill up all vacant positions with a request to refrain from frequent transfer of staff with experience in malaria control.

4.4.2 Early warning system: CMO/DMO would be provided with

the guidelines to detect and control the epidemics. MO PHC/DMO would be required to keep track of the unusual events on regular basis. These are the: i) Parasite load and follow increase in number of fever cases, species distribution of Pv and Pf; ii) Vector dynamics and follow increase in vector density, increase in breeding grounds of mosquitoes; iii) population dynamics related to influx of migrants from non-endemic to endemic areas and vice versa; tropical aggregation of population in projects; large labour movement to forest or for agriculture; population migration during floods and drought; iv) Environmental/climate conditions like early and heavy rainfall in pre-transmission season e.g., May/June in North India,and increased humidity during above period; and v) Natural disasters like floods following monsoon rains, drought resulting in drying up of river bed and other water bodies with pool formation, an earth quakes etc.

4.4.3 Control strategy: Panchayats through the health functionaries would be sensitive enough to raise alarm based on unusual fever incidence. Zila Parishad chief would receive information through the MIS and his contacts with the community to initiate immediate action by mobilizing resources at the district level. To fight the epidemic stocks of insecticides (synthetic pyrethroids) would be held in reserve at selected places @ 1 depot per 10 million population and supplies would be sufficient to meet emergency requirement of 100,000 population. After the transmission season, insecticide held in reserve would be used in the impregnation of bed nets and replaced with the

fresh insecticide before the onset of transmission season. These supplies would also be diverted to control epidemics in organizations which would be outside the ambit of NMEP for malaria control. Existing spray equipments, transport, other supplies and man power would be used in fighting epidemics and additional resources mobilized from neighboring areas. There would be adequate stocks of drugs and facilities for EDPT throughout the primary health care system for any eventuality. Epidemic control would be managed from the internal resources of the NMEP.

4.5 ASSESSMENT OF MALARIA SITUATION: Assessment would be in-built in the programme through the MIS system. Furthermore computerization of NMEP activities and supplies would be routinely monitored. There would be an annual assessment by the internal committee appointed by the state government. An external assessment would be organized by the NMEP comprising of national and international experts. Recommendations of the review committees would be followed and further actions would be suitably amended to incorporated new ideas/ strategies.

5. SALIENT FEATURES OF THE REVISED MALARIA CONTROL STRATEGY

5.1 Administrative:

5.1.1 Staff: No staff component is envisaged out of the world bank assistance. Whatever extra man power would be required, efforts would be made to manage the work by mobilizing existing staff or by hiring short term staff on contract basis out of the contingency grant. Payment to the link worker would be

made by the Panchayat and in the initial stages this expenditure would be reimbursed out of the WB assistance. To increase sustainability of this activity, other resources available to Panchayat would be mobilized and WB component of the assistance would be phased out over a period of 5 years.

5.1.2 Decentralization: Zila Parishad would be the nodal point to execute malaria control in the district. Village Panchayats are being involved in malaria control activities. A link worker would be hired by the village Panchayats for malaria control work.

5.1.3 Legislation: A uniform legislation would be adopted by the state governments on the pattern of Bombay Municipal Bye-laws.

5.1.4 Intersectoral committees: To elicit cooperation and help from non-health sectors intersectoral committees would be constituted at the Centre, state and district level with pointed reference to control mosquito breeding by preventive and corrective methods, and ensure proper maintenance.

5.1.5 NGOs and private sector would be encouraged to participate in malaria control and these institutions would be provided guidance and help to ensure improved delivery of health services.

5.1.6 Reviews: In addition to the in-built checks and monitoring, annual reviews of the malaria control programme would be organized by the states, and at 2 year interval independent

external assessment would be organized by the NMEP.

5.2 Financial:

5.2.1. Malaria control in the country would be done by mobilizing internal resources, by seeking cooperation of the non-health sectors, and by organizations outside the ambit of NMEP at their own cost.

5.2.2 Inter-country budget of WHO and extra-budgetary support would be utilize in training, emergency supplies and organizing external review/assessment of the NMEP.

5.2.3 WB assistance would be used in strengthening malaria control and malaria research in general and control of malaria in P. falciparum dominant areas in the 7 peninsular states.

5.3 Technical:

5.3.1 Introduction of bioenvironmental malaria control methods throughout the country viz., larvivorous fishes, environmental management methods, and health impact studies in all projects,

5.3.2 Phasing out insecticides in malaria control, exception being the use on bed nets/curtains and spraying under special situations and in emergency.

5.3.3 Early warning system with provision to prevent, detect early, abort and control epidemics.

5.3.4 Economic, social and applied research to strengthen

guide the programme activities.

5.3.5 Improved MIS by computerization of data at the district level and provision of E-mail and Fax at the regional offices and the state Hqs.

5.3.6 Training to non-health and private sector

5.3.7 Rapid absorption of new and emerging technologies in malaria control.

6. R & D SUPPORT TO NMEP

Basic and applied research at the MRC is finding direct application in the control of malaria unde the auspices of NMEP and the state health departments/Corporations, and the industrial sectors etc. Salient contributions are briefly described below:

1. Mosquito Biology: Studies at the MRC have revealed that Anophelines are the complex of sibling species. In An. culicifacies 4 sibling species have been discovered. Based on this knowledge it was possible to define the transmission dynamics of malaria in the country and reasons for the increased receptivity to malaria. This contribution was used by the review committee of the NMEP to revise the spraying strategy. This contribution saved vast areas from spraying thus incurring enormous savings to the NMEP. The study also brought out that health impact assessments are important as the areas coming under irrigation become more receptive to malaria thus increasing transmission, the

control of which requires active collaboration of the irrigation engineers. Similar studies with An. fluviatilis and An. annularis have established that the former is a complex of 3 species and the later of 2 species. The bilogy of each species, response to insecticide, vectorial capacity and the biting behavior is different and therefore transmission potential of each sibling species should be established before undertaking control (Subbarao et al 1988, Subbarao et al 1994).

2. Residual spraying of insecticides is the main stay of insecticides. An. culicifacies, the major vector of malaria has become multiple resistant and there were published reports by the NMEP of epidemic situationin areeas under the spray. MRC field tested deltamethrin and demonstrated the effectiveness of this new insecticide in malaria control and also established guidelines for spraying. This insecticide has since been inducted into the NMEP. Another major achievement was the demonstration of malarthion in Species A areas. A careful planning to spray when there are vectors and malaria could theoretically be a long term solution withour running into the problem of physiological resistance in the vector An. culicifacies (Ansari et al 1990)

3. Malathion thermal foging was used by the NMEP as a routine activity to control malaria in the urban and industrial areas. Thermal fogging is very expesive and was adding to an unwated load of chemicals in the environment. Studies by the MRC clearly demonstrated that thermal fogging should not be

LIBRARY AND DOCUMENTATION UNIT

used as a routine measure of malaria control and may be limited to epidemic control under certainsituation. As a result of this demonstration thermal fogging was withdrawn by the NMEP thus saving enrmous resources which were otherwise going waste (Sharma et al 1986).

4. A large number of teaching and traing modules, maerial in the shape of pamphlets, brochures, charts,video programmes have been produced y the MRC which are routinely used in the teaching and training of malaria and relatedd activities. A book on the Anophelines of India has been published which is demand by the entomologists (Nagpal & Sharma 1995).

5. In India fishes were introdued in malaria control in the 1930s and since the introduction of DDT in malaria control fishes occupied a back seat and were totally neglected. MRC revived fish production, demonstrated large scale production by the millions and billions, safety and cost effectiveness of fishes and linkingfish production with income generating scheme. This technology is being used in the country in vast rural areas in Gujarat e.g. all PHCs in Gujarat maintain a larvivorous fish hatchery. In urban areas fishes are being used more and more. In the bioenvironmental malaria control fishes occupy an important place in malaria control (Sharma, 1994).

6. Biolarvicides Bt and Bs have been tested alost throughout the world in the control of mosquito breeding. For the first time large scale use of biolarvicides was made in the

country by the MRC. It was unambiguously established that biolarvides are a practical and cost effective solution to the control of mosquito breeding. It was also shown that Bs may not be a good choice because or rapid buld up of resistance however Bt is a good candidate for large scale application. Basedon this research GOI has introduced biolarvicides in malaria control in the country (Kumar et al 1995, Kumar et al 1994).

7. Malaria control in India had become refractory to spraying and there were no easy solutions. Furthermore outbreaks were becoming common. MRC developed the bioenvironmental malaria control technology, demonstrated the successful application of these methods in malaria control in the rural, urban, industrial and coastal malaria. This was for the first time any where in the world such a big exercise was taken up. Results of this research are finding application inmalaria control in Kolar district in Karnataka where farmers do not accept spraying due to fear of loss to silk industry. These methods are being extended to other rural areas in Karnataka. The technology has also been applied in the control of urban malaria in Madras and Goa (Sharma 1987).

8. Dip Stick: Dip stick method of diagnostics was tested by MRC in tribal areas in the hands of field wirkers. Studies showed 94% specificty and 95% sensitivity. This methods is now ready for use in thediagnosis of malaria. It has beendeecided to allow the use of dip sticks in the private

sector and also it use in limited quantities under the primary health care system.

9. Atemisinin: The Chinese drug QINHAOSU was developed by the CDRI for the management of serious and complicated malaria cases and to treat drug resistant malaria cases. This drug has undergone clinical trials with the help of MRC inendemic areas. Phase III clinical trials have been completed and the drug would be released in the market shortly. This drug has been included inthe treatment of malaria undrer the primary health care system. through the MRC

10. Health Impact Assessment: Projects both irrigation nad industrial become malarious. As a result two new ecotypes have been established in the country e.g irrigation malaria, industrial malaria. MRC has carried out health impact studies to bring out the malariogenic potential of projects and recommends mitigaing measures. A large number of workshops have been conducted on the engineering methods of malaria control. As a result there is growing awareness among the planners and engineers and these methods are finding application in malaria control in the country.

11. Vector incrimination: To identify whether a mosquito is harbouring malarial parasite, mosquito dissections are routinely carried out to see the developing oocysts or the sporozoites. This method is very cumbersome and time comsuming as it requires dissection of an individual mosquito, some time running into couple of thousands particularly the zoophilic species and lacks correct identification of the Plasmodium species. It also requires

that freshly collected mosquitoes are dissected, and dissections of marginal vectors is rather problematical as very large number of dissections are required. Under the Indo-US Blue Ribbon Programme the newly developed technique of vector incrimination by using monclonal antibodies was transferred by New York University Medical School to MRC. This technique is now routinely used in the MRC in vector incrimination by using the two site immunoradiometric assay (IRMA) or the enzyme linked sorbent assay (Elisa). These methods provide correct identification of the malaria parasite, assays can provide information on the parasite load in the mosquitoes. It has distinct advantage as dead and stored mosquitoes can be assayed in pools and the time and labour required is very short. To give you an example between 1902-1955 a total of 1.3 million An. culicifacies were dissected in the country. These dissections gave 1775 mosquitoes with sporozoites (0.01 to 10.0% sporozoite rate). We applied the technique of IRMA in 1986 over a period of five month and assayed 6428 mosquitoes in our laboratoryy and found 28 (0.43%) mosquitoes positive for the malarial parasites. Assays also provided information on the identification of the species i.e., Pv or Pf or the mixed infection. This technique is extensively used by us in various entomological and epidemiological studies and final result are transferred to the NMEP. (Nanda et al 1994).

12. Blood meal analysis in mosquitoes: A micro-dot Elisa technique has been developed for the visual identification

of the source of blood meal in the mosquitoes. The blood meal identification methodology is simple and correct. Digested blood upto 40 hrs can be identified. Correct identification of blood meal is very important for various epidemiological interpretations and this can now be done very rapidly at low cost. This method is now routinely used in the centre for various studies in the MRC HQs and its field stations.

13. Neem Azadirachta indica A. Juss is a native of India. Neem tree has been referred to as the wonder tree of India, botonical marvel, village pharmacy, and the tree of all seasons. The useful role of neem in the prevention and management of vector borne diseases with particular reference to malaria has not received adequate attention. Recent studies on neem have revealed that neem oil offers tremendous opportunities of providing protection from mosquito bites and neem products can be applied in a variety of ways to control mosquito production. Salient features of neem research carried out at MRC is briefly discussed.

a) Action of Neem oil on the Malarial Parasite

We have examined the schizontocidal action of two fractions of neem oil. Results of studies with both the fractions of neem oil when tested on the Plasmodium falciparum in vitro and also P. berghei infection in the mouse produced no schizontocidal activity. Fractionation and further purification of neem oil has produced 9 compounds i.e., 3

from fraction A and 6 from fraction B. In another study quality of the neem oil was compared from 3 sources.

b) Larvicidal Action of Neem oil'

Larvicidal action of neem oiil was compared with various neem based formulations marketed for the control of agricultural pests. Results of these studies showed that neem based insecticide Neemark produced good larval mortality (EC90 An. stephensi 20 ppm, Cx. quinquefasciatus 89 ppm and Ae. aegypti 308 ppm) as compared to NSK methanoic extract, Achook, Neemrich I and Neemrich II. Ec90 values for these compounds were 100, 430 and 420 ppm respectively for the neem oil and several folds higher for the other formulations. Vectors of urban malaria (An. stephensi) and Dengue haemorrhagic fever (Aedes aegypti) which are difficult to control by conventional methods could be effectively controlled by soaking of balls prepared out of wood scrapping in 10 ml of 5% neem oi. However this mode of application was not found feasible as it also killed non-target species.

c) Joint Action of Neem oil and Biolarvicide

To increase effectiveness of neem oil and reduce application dosages, neem oil was mixed with the 2 biolarvicides Bacillus thuringiensis variety israelensis (Bt) and Bacillus sphaericus. The mortality in the malaria vector An. culicifacies at 40 ppm after 72 hrs. was 80% and with B. sphaericus @ 10 mg/lit was 54%, but a combination of the two produced 93% mortality. Similar results were obtained with

Bt but the residual action was short lived. The formulated products on storage produced fowl smell and these formulations were found unsuitable for large scale production and application in the control of mosquito breeding.

d) Control of Vectors of JE

Rice fields produce enormous mosquito populations, particularly Culex vishnui group and Cx. tritaeniorhynchus, the vectors of Japanese encephalitis (JE). Application of good quality of neem cake powder applied @ 500 Kg/ha. either alone or coated with urea produced striking reduction in the breeding of culicine mosquitoes in south India.

e) Repellent Action of Neem Oil

To study the repellent action of neem oil on the malaria, filaria, DHF vectors and nuisance mosquitoes; and also on the sand flies the vectors of Kala Azar and oriental sore neem oil was diluted in various oils for application on the exposed body parts and also for burning or for vapourization. These diluted oil preparations were tested in various endemic villages to provide protection from the bites of haematophagous insects. Results of these studies reveal. Neem oil produce high degree of repellent action on all biting insects and the repellent action lasted for 7 to 12 hours. There was complete protection for the first 3 hours and some insects were seen approaching the bait. The protection reported here is based on the landing rates and

not on the biting rates. Protection from biting insects would be much higher and in prevention of disease transmission biting protection is important whereas landing protection provides indication of the prevention from nuisance value. The percent protection provided exceeded 70-80 and mostly for the anophelines it fluctuated between 90-99%.

14. Slow release spray formulation of insecticides: Under the auspices of the WHO, Rio University scientists have developed a technique of the slow release of residual insecticides. This technique is very useful as the quantity of insecticide to be sprayed on the walls remains the same but the release of insecticide is regulated by mixing this with polymers routinely used in the manfacture of a variety of paints. Although the cost of insecticide increases marginally but atleast 3 round are eliminated. This has great operational advantage and overall cost of the spraying programme is low. The technique is also environmental friendly as less insecticide is introduced in the environment. MRC has arranged field studies on this product and the method is now currently under test in the control of sandflies in Bihar.

15. Malathion spraying to control malaria: As a result of our researches on the sibling species complex in An. culicifacies a lost of information has been generated on the mechanism of insecticide resistance, its evolution and coutermeasures to tackle the intractable problem of

insecticide resistance in the vectors of malaria, particularly the An. culicifacies. We have clearly shown that spraying of DDT in north and south India can produce epidemiological impact since species A is susceptible to DDt and it is the sole vector species in these areas. In another study we have shown that evolution of resistance in species A to malathion is very slow because of the rate gene frequency. Malathion spraying in species A areas could be used as a very cost effective and sustainable strategy by spraying only when the vector populations starts building up and there is evidence of transmission. Our studies have shown that spraying of 2 or 3 rounds will eliminate malaria for several years and spraying should only be resumed when there is evidence of transmission. This would save resources, prevent the insecticide associated hazards, and extend the useful life of malathion. In areas with the prevalence of species C malathion spraying should be withdrawn as resistance appears rapidly thus making the spraying useless in a period of 2 to 3 years. Unfortunately the practice of blanket spraying followed from the times of eradication period is causing control failures by repeated spraying which eventually results in the precipitation of resistance. This also eliminates the possibility of extending of the useful life of insecticides which are not only costly and hazardous but the choice of replacement insecticides is limited. Our researches have resulted in the rational approaches to control of mosquitoes by chemicals,

thus chemical control becomes more cost effective, sustainable and environmental friendly (Raghu et al 1992).

6. Selective spraying: A study was taken up on the spraying of houses alone and compared it with the spraying of houses and the cattle sheds. In this field study two spraying programmes were also introduced for comparison. The usual dosage of spraying of DDt @ 1 gm/sq m was increased to 2 gm/sq m to see whether enhanced dosage of spraying of DDT will improve malaria control. These three spraying strategies were compared with the HCH spraying which was the insecticide sprayed at that time @ 0.2 gm/sq m to control malaria. This field study was carried out in Ghaziabad district villages and each strategy covered all villages of a primary health centre (PHC). Results of the study revealed that HCH spraying was not useful in the control of malaria at all as the SPR and cases per 1000 population were the highest i.e., 35.5 and 193.6 respectively. There was reduction in the transmission in all other areas under DDT spray. Spraying of houses alone, houses and cattle sheds, and enhanced DDT dosage produced SPR and the cases per 1000 as : 22.8 and 84.0, 19.9 and 64.9 and 20.7 and 77.3 respectively. The level of reduction in the three areas was statistically non-significant. Therefore at that time it was recommended that DDT spraying should be restricted to houses alone and there was no advantage of increasing the dosage of DDT to 2 gm/sq m. Spraying of cattle sheds was a wasteful expenditure and should be avoided. This study assumes

special importance in the malaria programmes. The current practice is on more coverage of cattle sheds. This is mainly because of high refusal rates of accepting the spraying by the house holders in the rural areas. It may be noted that over the years spraying of chlorinated hydrocarbon (DDT, HCH) insecticides haas declined and there is an effort to phase out these insecticides in favour of biogradable insecticides and bioenvironmental methods (Ansari et al 1988).

17. Insecticide impregnated bed nets: Mosquto bed nets have been used in the world for almost time immemorial as a standard method of protection from the bites of mosquitoes. Bed nets found greater publicity and acceptability following the incrimination of mosquitoes in the transmission of malaria for which Sir Ronald Ross was awarded the Noble prize. In recent years insecticide impregnated bed nets have become an important method of malaria control in many endemic countries. Our own studies in Assam and Orissa have clearly brought out the usefulness of the impregnated bed nets in the control of malaria transmission. We have field tested a variety of synthetic pyrethroid insecticides and found these highly useful in the treatment of bed nets @ 25 mg/sq m. Success of bed net programme will mainly depend on the biting behaviour of mosquitoes and also the cultural habits of the populations. Based on the vector behaviour and related studies we have stratified the country where bed net programme will produce impact on transmission. These areas

are the north and south India and north eastern states. In all other areas the bed net programme is unlikely to produce any significant reduction in malaria transmission. The impregnated bed net programme has been accepted by the Assam Government and many industries in Assam now provide impregnated bed nets to their employees. Bed nets treated with insecticides are cost effective method of protection from malaria and mosquito nuisance. The method is indigenous and sustainable (Janakara et al 1995).

8. Malariogenic stratification: Malaria is a local disease and its profile in the field is highly variable with contiguous areas of endemicity. The homogenous regions could be separated from the neighbouring areas by simple methods of using a fixed parameter such as the API. However a combination of many parameters such as epidemiological, entomological, human ecology and intervention methods when superimposed could provide a very useful information on the cause and effect relationship in the chain of malaria transmission. It is also possible to utilize this technique in making prediction and in planning of malaria control operations which are cost effective, sustainable and utilize indigenous resources. In recent years we have stratified the state of UP by using parameters related to the water bodies, soil profile, vegetation, and human and cattle population. These parameters when given the weightage gave us mosquitogenic potentital of the entire state of UP districtwise. This stratification was improved by using

water bodies specific to the breeding of Anophelines. It was then possible to stratify UP according to the risk of malaria. This stratification was checked with the sibling species distribution and also be estimating vectorial capacity. This stratification provided a realistic situation of malaria in various districts of UP. Using this technique it was possible to stratify Karnataka state for the bioenvironmental interventions. In this connection it is noteworthy to mention that stratification is a dynamic process and there is a need to update stratification maps periodically.

19. Expanded polystyrene beads: EPS beads were introduced in the country for the first time by us in the control of mosquito breeding. A unit was established with mobile team for the production and introduction of beads in rural areas. The method is very useful in the control of mosquito breeding in places where air current does not interfere with the beads. One application provides long lasting control of all mosquitoes on a sustained and cost effective basis (Chandrahas and Sharma 1987).

20. Health Education: This aspect of the malaria control programme has received scant attention in the past. However under Primary Health System, both powers and responsibilities are shifted to the communities. As a response to these requirements for a successful malaria control programme involviing the communities is absolutely essential. Towards this objective we have prepared a variety of health education material comprising of video films,

brochures, pamphlets, exhibitions etc. These programmes have been widely publicized, some of the activities have been routinely exhibited on the national television net work and in the national exhibitions organized in various parts of the country. As a result of health education in many areas there is much better awakening in the communities and one can find people cleaning their surroundings and removing water stagnation. The treatment of malaria has also improved considerably in many areas under our operations.

21. Community participation: In the bioenvironmental control of malaria, for the first time communities have been mobilized to control mosquito breeding, participate in the income generating schemes, start using and caring of the mosquito bed nets and go for blood film examination in case of fever, take full course of the antimalarials etc. For those who are interested to know more details of the community action they are advised to read our book on community participation in malaria control available from the centre (Sharma 1993).

22. Awareness workshops for Non Health sectors for control of malaria: Generation of high mosquitogenic potential with development projects viz. urban development industrial development, irrigation mining etc. is well documented. As a part of awareness campaign for engineers, architects, town a planners, administratives. Centre has organized several workshops for preventions of mosquitogenic potential in the first instance at the designing, planning, execution and

maintenance phases. These activities have covered local civic bodies, housing corporations and boards central and state public works deptts, railways, defence (Army, Navy, Air Force and Border Road Organizations) and Public and Private sector organizations viz. irrigation projects, tea estates etc.

7. POLICY CONSIDERATIONS

7.1 SUSTAINABILITY

A major reason for the upsurge of malaria was the lack of sustainability in field operations. In fact it had started from the early 1960s when DDT supplies were stopped and USAID advised procurement of DDT against hard currency which was not available. Soon thereafter reverses occurred resulting in 20-30% shortages (Sharma and malhotra, 1986). Escalation in the cost of insecticides and compromise in the areas to be sprayed has become a regular feature. In the drafting of revised malaria control strategy sustainablity factor has been given due weightage at each step of the field operations. A brief account is given below.

7.1.1 Malaria control is being strengthened all over the country. This would result in improved health and exploitation of natural resources; boost agriculture and industrial production and increase GNP. Better national economy would provide improved quality of life, and opportunities of the use of personal protection methods and seek correct treatment.

7.1.2 WB assistance would be utilized to procure equipment supplies, training, strengthing research support and labour etc.,

Panchayat will function as FTD, supervise link worker, promote bed net programme in the communities, and encourage the use of personal protection methods e.g. neem oil. Some of the experience during the implementation of the modified plan of operation would be useful in developing elements of community participation in the revised malaria control strategy. These are the following.-

7.2.1 Spraying: Mud plastering of sprayed walls has been a problem since inception. Spraying would be effective if mosquitoes come in contact with the insecticide sprayed surfaces. Mud plastering of walls is done frequently in the tribal populations (walls are mud plastered 10-12 times a year or more). A study by the NMEP showed that, based on 25% tribal population in a PHC, 7.8% population (which is classified as tribal), contributes 39% malaria, 67.62% P. falciparum and >50% deaths due to malaria. There are also the areas refractory to spraying and largely associated with resurgence. As per 1994 figures about 68.66 million population of India is tribal settled in NE and 7 states of peninsular India (Pattanayak et. al. 1994). Efforts made by NMEP through health education have not been very successful. Other population living in rural areas also practice mud plastering, but only during the festival season or on any special occasion and spraying remains by and large effective.

7.2.2 Bee keeping: In some areas (predominantly NE states) bee keeping is a major agricultural produce. In these areas farmers strongly resent spray programme as they fear harmful effect on bees and contamination of honey and in these areas spraying has been a problem.

7.2.3 Silk culture: India has emerged the 3rd largest exporter of silk. GOI is making efforts to boost silk production and capture the world market further. Silk production in 1950 was 0.89 m kg, in 1981 5.04 m kg, and in 1991 10.9 m kg. Silk industry also provides 3.8 million jobs. India's 90% silk is mulberry and 10% non-mulberry (Tassar). Major proportion of this produce comes from tribal areas. Farmers do not want any chemical in silk growing areas because they fear chemical contamination and harmful effect on silk worms. In these areas e.g. (NE states, orissa, M.P., U.P.) refusal rates to spraying are very high, and the coverage seldom exceeds 25%.

7.2.4 Housing: Most houses are made of bamboo, mud, thatched roof and provide easy entry and ideal resting surfaces. Invariably a cattle shed is attached to the house. Tribal villages are not compact, and houses (2 or 6) are scattered in the agricultural fields. Most villages have poor accessibility, particularly during the monsoon season, which coincides with malaria transmission. Travel to nearest medical facility may take a few hours and most poor people have no transport, some have cycle and animal driven cart etc.

7.2.5 Mis-use of insecticide: There are many instances when insecticide for spray was diverted to agriculture. Residue problem in food is largely associated with this. DDT and HCH accumulate in biological systems and re-cycle in nature. Poor supervision has aggravated this situation.

7.2.6 Sleeping habits: This is a complex issue as this behaviour profoundly affects malaria transmission. Some generalizations can be made as studies are few and limited in scope. In general,

children and women sleep indoors and men folk outdoors. In the arid, semi-arid and deciduous dry regions of the country people sleep outdoors (prefer open verandah) during hot season. In deciduous wet, high rainfall and coastal areas they sleep indoors. In an insecticide treated bed net programme people should enter bed nets before mosquitoes become active. Children sleep early but adults go to bed after 9 or 10 p.m. thus contracting malaria by early biting vectors (e.g. An. culicifacies species). In consideration of this behaviour bed net programme should be targeted to high risk groups e.g. children, pregnant women and non-immune immigrants; while general use of bed nets should be encouraged. generally people are poor and they are half clothed. In some tribal areas most body is exposed thus increasing the risk of acquiring infection.

7.2.7 Treatment seeking: PHCs are often located at long distances, poorly staffed, drugs are in short supply and many of the PHCs are still not fully functional. MPW is expected to visit at 15 day interval for EDPT but there are 40-50% vacancies. People either take their own herbal treatment or go to quacks, witchcraft, local healers etc. Some people avoid modern medicines, and fear harmful after effects.

7.2.8 Education: Literacy rate in P. falciparum dominant areas is very low, and this may be a serious obstacle in introducing new technologies and eliciting community participation. Therefore ingenious methods of IEC on folklore may have to be developed.

7.2.9 Water: Spaying requires water. In some areas (mostly hilly and drought affected) water is scarce and has to be brought from

far off places. Spray squads force people to provide water for spraying and washing. This causes harassment and induces people to refuse spraying. There is acute shortage of water in almost all rural and peri-urban areas. By the year 2000 piped water supply is targeted for 95% urban and 100% rural population. Due to shortage and rationing of water, water is stored in tanks and a variety of containers. water supply is diffusing an. stephensi and Aedes aegypti (Dengue vector) rural areas. In urban areas malaria resurgence is closely associated with the piped water supply. This problem is more pronounced in peri-urban and studies have revealed that DHF outbreaks in rural areas associated with piped water supply.

7.1.10 Community: Figure shows the interaction of various activities to optimise community participation. In the revised malaria control strategy social elements will profoundly effect the success of interventions. Special interest of the communities would be required and shall be elicited in the activities related to the: bed net usage and up keep; consent to spray all structures and dwellings, sleeping habits t increase impact of bed nets; faith in modern medicine; use of fish in water bodies; community mobilization for voluntary work; prevention of creation of borrowpits, preventive vector control in the construction of houses and water storage containers and adoption of methods to prevent man mosquito contact i.e. the use of repellents, screening of houses wherever possible, proper clothing etc.

7.2.11 Clothing: People prefer to sleep with minimum clothing during summers and rainy season. Some tribals remain naked as a

cultural habit. Proper clothing can prevent mosquito bites and thus protect from malaria. This human behaviour has been successfully exploited in the defence forces i.e. the "Malaria Curfew" requiring all personnel to use full pants and sleeves down etc.

7.3 OCCUPATIONAL

The following major occupations in India have some relationship to malaria.

7.3.1 Agriculture: Rice fields per se have negative correlation with malaria, but An. culicifacies and an. fluviatilis breeds in the rice agro-ecosystem. Rice paddy cultivation has registered a phenomenal rise in the country. In 1951 rice acreage was 30.8 mh and in 1993 this has increase to 41.6 mh. Because of high water requirement by the paddy, there is high relative humidity in nearly villages thus increasing the longevity of mosquitoes. This may increase receptivity to P. falciparum. In many southern states irrigation has made it possible to grow 2 or 3 crops of rice in a year thus extending the period of mosquito production from the rice fields. There is a direct relationship of rice fields to JE epidemics (Sharma, 1995).

Sugarcane cultivation increased from 1.7 mh in 1951 to 3.6 mh in 1993. Since the watering requirements of this crop is high, this induces rise in sub-soil water level and ponding thus creating conditions favourable for vector breeding and increase in malaria endemicity. Flood irrigation creates a large number of stagnant water bodies in and around sugarcane fields where

malaria (An. culicifacies) mosquitoes breed. Application of insecticides in agriculture precipitates resistance in malaria vectors. This has been demonstrated in An. culicifacies species C in Orissa and Andhra pradesh (Subbarao et.al. __). In tea gardens labour huts are located near the streams. these are the sites fro the breeding of An. minimus and An. fluviatilis. malaria transmission is very high in the tea gardens labour settlements, although tea gardens are well drained.

7.3.2 Industry: Most of the industries are located in malaria endemic areas. some industries draw raw materials from the forests and some are engaged in mining creating borrowpits for the breeding of mosquitoes. Invariably industrial areas lack zooprophylaxis. Labour is settled in in unhygienic conditions without provision of adequate water supply and drainage. Industries alsc come up in water logged areas and in the waste land. receptivity to malaria is high. Labour from endemic areas bring infection and spread malaria.

People on patrol duty in police, para-military force and in the defence forces are excessively exposed to mosquito bites and constitute an important high risk group.

Nomadic behaviour of some tribes (e.g. in rajasthan) and long stay in forests for animal grazing are other activities which promote dissemination of malaria.

7.3.3 Forests: Population settled in the forests go for collectionof forest produce in the midnight, they are poorly clothed ignorant, live in temporary shelters and constantly

expose themselves to the bites of mosquitoes. Malaria is a common disease in these areas. Access to malaria treatment is poor most people belong to poor income group; frequent infective bites cause high mortality, protected illness and finally large population groups become carriers.

7.4 ECOLOGICAL

The following ecological elements bring about major epidemiological settings of malaria. Figure shows the map of ecological zones and distribution of vectors.

Ecological zone	Characterstics	Transmission potential
1. Arid zone	<50 cm rainfall	Main vector An. stephensi which maintains endemic malaria. Transmission is exacerated by An. culicifacies during years of high rainfall.
2. Semi-arid zone	<50 cm rainfall	Similar characterstics with relatively high intensity of transmission.
3. Deciduous dry	50-100 cm rainfall	Seasonal transmission with An. culicifacies during monsoon. Some pockets in forest hills with An. fluviatilis transmission maintaining meso-endemicity and focalized outbreaks.
4. Deciduous wet	100-200 cm rainfall	Meso to hyper-endemic malaria with Pf predominance due to relay transmission by An. culicifacies and An. fluviatilis.
5. Tropical monsoon	>200cm rainfall	Stable hyper-endemic malaria with high asymptomatic carriers and no epidemics. Transmission maintained by An. minimus, An. dirus and An. fluviatilis in super-imposed fashion.
6. Coastal zone (A&N islands)	outbreaks	Meso-endemic malaria with focal maintained by localized populations of An. sundaicus. Lakshadweep in the Arabian sea is an island but due to lack of vector there is no malaria.

7.5 ENVIRONMENT

Mosquitogenetic conditions and malaria receptivity is increasing all over the country as a result of developmental changes under the 5-year development plans. Some environmental factors have influenced malaria transmission profoundly by encouraging vector breeding and as a consequence enhanced transmission of malaria. These are the following:

7.5.1 Population: Population in India has registered a phenomenal growth. In 1951 India's population was 361 million and in 1991 it was 860 million, heading towards 1 billionmark towards the end of this century. Malaria thrives in poverty, and in this context it may be relevant to point out that in 1994 population below poverty line is more than the total ppulation in 1951 i.e. > 400 million. Most dramatic rise has been in the urban population and growth of towns. Urban population increased from 62 million in 1951 to 217 million in 1991 and towns from 2,843 in 1951 to 3,768 in 1991.

7.5.2 Irrigation: Seventy percent of the population lives in villages, and > 32% GNP comes from agriculture. Population has made unprecendented demand resulting in growth of various sectors e.g. agriculture, industry, human settlement, commerce and industry etc. To increase agriculture production irrigation was given priority and included in the Prime Minister's 20 point programme. Irrigation has increased from 22.6 millin hectares to 91 million hectares in the 1990s. Construction of barrages and dams leave the down stream dry and slow seepage and water leaks keep the water in the puddles of river beds where An.

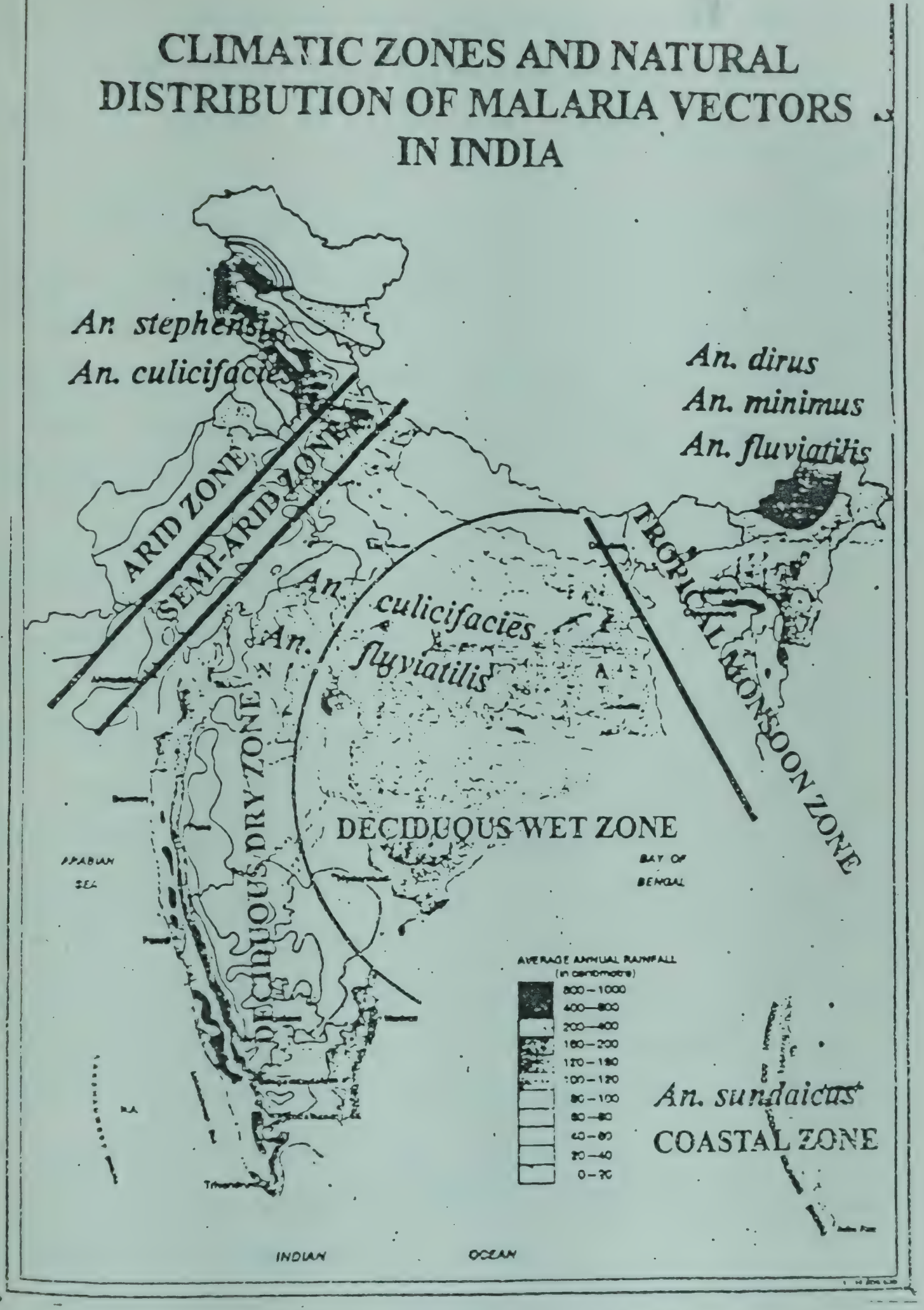


Figure 4: There are six major vectors of malaria in India. Figure shows the area of influence of each vector An. culicifacies is the vector of rural malaria and produces 60-65% new cases each year. An. stephensi is the vector of urban malaria and produces 10-15% cases each year. other vectors An. fluviatilis, An. minimus, An. dirus and An. sundaicus have local importance due to limited distribution but are efficient malaria vectors.

culicifacies breeds. Profusely vector breeding is also encountered in irrigation waters and in the command areas. In the slow running streams created by the seepages from dam, An. fluviatilis breeds to take over transmission from An. culicifacies.

7.5.3 Piped water supply is targeted for 95% urban and 100% rural population by the year 2000. An. stephensi breeds in piped water supply and therefore due to urbanization, industrialization and water supply in rural areas, influence of An. stephensi has increased enormously bringing new areas under malaria transmission.

7.5.4 El Nino brings drought in India. Drying puddles in the river beds provide breeding grounds for A. culicifacies. In Sri Lanka major epideics of malaria are associated with droughts. Droughts also cause large scale population migration to irrigated areas thus spreading malaria.

7.5.5 Rice fields in India have no relationship to malaria unlike in Indonesia, but rice agro-ecosystem supports heavy An. culicifacies breeding and in the slow running channels An. fluviatilis, thus adding to the existing load of vectors in the area and promoting transmission by extending longevity as a result of hgh humidity. Rice acreage has increased from 30.8 mh in 1951 to 41.6 mh in 1991, and this major ecologial change in rice growing areas needs to be studied in relation to disease transmission. There is enough evidence of direct relationship of rice fields to JE epidemics.

7.5.6 Flood irrigation is required to grow the cash crop of sugarcane. This raises water table and fills the borrowpits and

ditches along the sugarcane fields. Villages with high sugarcane cultivation experience high transmission of malaria. Area under sugarcane has increased from 1.7 mh in 1951 to 3.6 mh in 1991.

8. FINANCIAL OUTLAYS (WORLD BANK COMPONENT) given in Tables

TARGETING MALARIA CONTROL ACTIVITY FLOW CHART

TOP DOWN

NMEP

R&D → ← UN, Bilateral

IEC, MIS, HIA, Decentralization, filling vacancies, EMM, municipal and building bye laws, training, drugs, biological control and maintenance of ongoing activities.

← RD - Transport
- E-mail

States/U.T.

Rural malaria control

Urban malaria control

Regular NMEP

(100% Central Assistance) NE States

50:50 sharing Basis

Regular NMEP+WB States(7) 50:50 sharing Transport E-mail

(Regular NMEP) 72 Entomological zonal units transport, microscope, equipments

Zone ← → Zone

Distt.

Community Health Centre (CHC)

PHC

Village

Distt (97) (Zila parishad) Transport, E-mail, Fax, Bednet EDPT, Dipstick

Community Health Centre Microscopes, drugs

PHC (1045) I Referral, Drugs Palm top

Village Panchayat Link worker, FTD

Sectors outside NMEP

Regular UMS Towns

Regular UMS + WB Towns(19)

APCD Microscope Dipstick, Bt Sealing OHT

1. Community Participation: Source reduction, Bed net treatment, Seeking treatment
2. Private Sector: Clinics, Dipstick, Drugs, Bed nets, Repellents
3. Social Marketing: Revolving fund, Sealing of containers, Deposit work.

BOTTOMS UP

9. REFERENCES

1. Ansari, M.A., V.P. Sharma, R.K. Razdan, C.P. Batra and P.K. Mittal (1988). The value of spraying cattlesheds in a control programme. Ind. J. Malariol., 25(1): 17-22.

2. Ansari, M.A., V.P. Sharma, R.K. Razdan and P.K. Mittal (1990). Field evaluation of Deltamethrin against resistant Anopheles culicifacies in distt. Ghaziabad (U.P.), India. Ind. J. Malariol., 27(10): 1-13.

3. Covell, G. (1928). Malaria in Bombay. First Printed at the Government press (1928). Reprinted by Malaria Research Centre (1990).

4. Das, P.K., K. Gunasekaran, S.S. Sahu, C. Sadanandane and P. Jambulingam (1990). Seasonal prevalence and resting behaviour of malaria vectors in viraput, Orissa. Indian J. Malariaol., 173-187.

5. Jana-Kara, B.R. Wajihullah, B. Shahi, Vas Dev, C.F. Curtis and V.P. Sharma (1995). Deltamethrin impregnated bednets against Anopheles minimus transmited malaria in Assam, India. Jour. Trop. Med. and Hyg, 98: 73-83.

6. Jana Kara B.R., W.A. Hihullah, B. Shahi, Vas Dev, C.F. Curtis and V.P. Sharma (1995). Deltamethrin impregnated bednets against Anopheles minimus transmitted malaria in Assam India. J. Trop. Med. Hyg., 98: 73-83.

7. Kalra, N.L. (1991). Forest Malaria Vectors in India Ecological characteristic and epidemiological implication. In Forest-malaria in Southeast Asia ed. by V.P. Sharma and A.V. Knodrashin. Malaria Research Centre, Delhi.

8. Kondrashin, A.V. (1992). Malaria in the WHO Southeast Asia Region. Indian J. Malariol., 29: 129-160.

9. Kumar, A., V.P. Sharma, P.K. Sumodan, D. Thavaselvam and R.H. Kamat (1994). Malaria control by utilizing Bacillus sphaericus against Anopheles stephensi in Panaji, Goa. J. Amer. Most. Cont. Assoc., 10(4): 534-539.

10. Mishra, J. Nandi and Shiv Lal (1995). Chloroquine vesus amodiaquine in the treatment of Plasmodium falciparum malaria in northeast India Ind. J. Med. REs., 102: 119-123.

11. Misra, S.P. (1995). In-vivo resistance to chloroquine and sulfa pyrimethamine combination in Plasmodium in India. National Academy of Sciences, India communicated.

12. MRC (1993). Progress Report of Biolarvicides in Vector Control. Progress Report, Malaria Research Centre, Delhi.

13. M.R.C. (1993-95). Unpublished results and annual reports of the Malaria Research Centre, 22- Sham Nath Marg, New Delhi-110 054.

14. NMEP (1960). Manual of the malaria Eradication operation (1960). National Malaria Eradication Programme Directorate, Delhi.

15. Nagpal, B.N. and V.P. Sharma (1994). Indian Anophelines, Oxford Press, 56 Janpath, New Delhi pp. 425.

16. Nanda, N., H. Joshi, S.K. Subbarao and V.P. Sharma (1994). Two-site immunoradiometric assay (IRMA): Detection, efficiency, and procedural modifications. J. Amer. Mosq. Cont. Assoc. 10(2): 255-227.

17. NMEP (1986). Malaria and its control in India Vol.-III and I. NMEP Directorate, Delhi.

18. NMEP (1995). Indepth evaluation report of the modified plan of operation under National Malaria Eradication Programme of India. Directorate of NMEP, Delhi.

19. Pattanayak, S. and R.G. Roy, (1980). Malaria in India and Modified Plan Operation for its control. J. Com. Dis. 12: 1-14.

20. Pattanayak. S. V.P. Sharma, N.L. Kalra, V.S. Orlov and R.S. sharma (1994). Malaria Paradigms in India and Control Strategies Ind. J. Malariol., 31: 141-199.

21. Raghuvendra, K., S.K. Subbarao, K. Vasantha, M.K.K. Pillai and V.P. Sharma (19920. Differential selection of malathion resistance in Anopheles culicifacies A & B (dipthera: Culicidae) in Haryana state, India. Jour. Med. Entmol., 29(2): 183-187.

22. Ray A.P., M.V.V.E. Narasimham, A.V. Kondrashin and Annakani Bill. (1988). P. falciparum containment programme ten years of operation in India. (1978-88). NMEP/WHO/SIDA, published by the NMEP Dte. Delhi.

23. Sehgal P.M. M.I.D. Sharma, S.L. sharma and S. Gogai (1973). Resistance to chloroquine in falciparum malaria in Assam State India J. Com. Dis., 5: 175-180.

24. Sharma G.K. (1987). A ciritical review of the impact of insecticide spray under NMEP as malaria situation in India, J. Com. Dis., 19: 187-290.

25. Sharma R.S. (1995). Malaria Action Programme based on Expert Committee Report (1995). NMEP, Delhi.

26. Sharma V.P. Community Participation in malaria Control (book), Malaria Research Centre, Delhi.

27. Sharma V.P. and K.N. Mehrotra (1986). Malaria Resurgence in India: A critical study. Social Sci. and Medicines, 22: 835-845.

28. Sharma, V.P., G.K. Sharma, M.A. Ansari, P.K. Mittal, R.K. Razdan and C.P. Batra (1986). Impact of malathion thermal fogging on mosquito populations in Delhi and its place in malaria control. Ind. J. Malariol., 23(10): 65-67.

29. Sharma, V.P. (1987). Community-based malaria control in India. Parasitology Today, (397): 222-226.

30. Sharma, V.P., M.A. Ansari and R.K. Razdan (1993). Mosquito repellent action of neem (Azardirachta indica) oil. J. Amer. Mosq. Cont. Assoc., 9(3): 359-360.

31. Sharma, V.P. and R.C. Dhiman (1993). Neem oil as a sand fly (Diptera: Psychodidae) repellent. J. Amer. Mosq. Cont. Assoc., 9(3): 364-366.

32. Sharma V.P., B.N. Nagpal and Aruna Srivastava (1993). Effectiveness of neem oil mats in repelling mosquitoes. Trans. R. Soc. Trop. Med. Hyg. 87: 626.

33. Sharma, V.P. and A. Ghosh eds.(1994). Larvivorous fishes of Inland ecosystem. Malaria Research Centre, Delhi.

34. Sharma, V.P., N.L. Kalra, S. Pattanayak, R.S. Sharma and V.S. Orlov (1994). National Malaria Control Strategy. Malaria Research Centre, Delhi.

35. Sharma, V.P. Chusauk Parasitinuk and A.V. Kondrashin (1991). Magnitude of target related malaria in the WHO southeast Asia Region, pp. 29-54 in V.P. sharma and A.V. Kondrashin (ed). Forest Malaria in Southeast Asia. Malaria Research Centre, Delhi.

36. Subbarao, S.K., N. Nanda, K. Vasantha, V.K. Dua, M.S. Malhotra, R.S. Yadav and V.P. Sharma. Population cytogentics evidence for three sibling species in Anopheles fluviatilis (Diptera: Culicidae). Ann. Entomol. Soc. Amer. 87(1): 116-121.

37. Subbarao, S.K., V. Vasantha, H. Joshi, T. adak, K. Raghuvendra, V.P. Sharma and G.K. Sharma (1988). Anopheles culicifacies: Sibling species composition and its relationship to malaira incidence. Jour. Amer. Mosq. Cont. assoc. 3910: 29-33.

38. WHO (1978). Alma-Ata (USSR). Global Strategy of health for all by 2000 A.D.WHO Geneva

39. WHO (1992), WHO committee Report on malaria. Nineteenth Report. WHO/CTD/92.1 Geneva.

40. WHO (1993). A global strategy for malaria control: WHO Geneva.

41. WHO (1993). Implementation of the revised Malaria Control Strategy. WHO/SEARO, Delhi.

AVAILABLE WITH CHC FOR REFERENCE

ANNEXURES - CONTENTS

1). National Malaria Eradication Programme — Pg 1.
Epidemiological Data: 1976 & 1984 onwards — Pg 3.
2). Rajasthan : Epidemiological Situation — Pg 6.
3). Manipur : Epidemiological Situation — Pg 8.
4). Nagaland — Pg 10.
5). National Malaria Eradication Programme: Proposal on 100% Central Assistance to North-Eastern States — Pg 1.
6). Organisational Chart of the National Malaria Eradication Programme.
7). Drug Policy on Malaria
8). IEC Strategy for National Malaria Eradication Programme — Pg 1-5.
9). Observation of Malaria Week - Guidelines — Pg 6-8.
10). Training Needs — 14-18 pg
11). Management Information System
12). MIS for NMEP - Flow Chart
13). MIS for NMEP - Cost Estimates Chart (1a,1b,2a,2b,3a,3b).
14). Legal Provisions for Mosquito/Malaria Control (BMC Act) — Pg 14-21.
15). Proposal for incorporation of "Anti-Mosquito Measures" in the building Bye-laws, DELHI — Pg 1-4.
16). Table: Cost estimates of microscope requirements.
17). Table: Requirement of Link workers and Expenditure
18). Table: Dipstick test
19). Chart: Additional Requirements and Expenditure (PF predominant areas).
20). Chart: Additional Requirements & Expenditure (non-PF PHCs)
21). Chart: Transmission Control Measures & Expenditure - State-wise — Pg 6-10.
22). Table: Budget for fish hatchery (yearwise breakup)
23). Table: Technical requirement & Expenditure Statement of various States.
24). Table/Chart: State-wise detailed budget estimate for 5 years.
25). List of acronyms-their expansions used